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CONCORDE NOISE-INDUCED BUILDING VIBRATIONS

MONTGOMERY COUNTY, MARYLAND - REPORT NO. 3

By

Staff-Langley Research Center

August 1976

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16. Abstract This is the third report on a series of studies to assess the noise-induced building vibrations associated with Concorde operations. The approach is to record the levels of induced vibration and associated indoor/outdoor noise levels resulting from aircraft and nonaircraft events in selected homes, historic and other buildings near Dulles International Airport. Presented herein are representative departure data recorded during August 1976, at three home sites in Montgomery County, Maryland, ranging from 21 to 32 kilometers from Dulles Airport. At each site, the building response resulting from aircraft operations was found to be directly proportional to the overall sound pressure level and approximately independent of the aircraft type. The noise levels and, consequently, the response levels were observed to be higher for the Concorde operations than for the CTOL operations. Furthermore, the vibration could be closely reproduced by playing aircraft noise through a loudspeaker system located near the vibration measurement location. It thus appears that a sound reproduction system may be used to predict or compare the building response to Concorde operations or to determine building response for community surveys. Nonaircraft events such as door closing were again observed to result in higher response levels than those induced by aircraft.

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SUMMARY

This is the third report on a series of studies to assess the noise-induced building vibrations associated with Concorde operations. The approach is to record the levels of induced vibration and associated indoor/outdoor noise levels resulting from aircraft and nonaircraft events in selected homes, historic and other buildings near Dulles International Airport. Presented herein are representative departure data recorded during August 1976, at three home sites in Montgomery County, Maryland, ranging from 21 to 32 kilometers from Dulles Airport. At each site, the building response resulting from aircraft operations was found to be directly proportional to the overall sound pressure level and approximately independent of the aircraft type. The noise levels and, consequently, the response levels were observed to be higher for the Concorde operations than for the CTOL operations. Furthermore, the vibration could be closely reproduced by playing aircraft noise through a loudspeaker system located near the vibration measurement location. It thus appears that a sound reproduction system may be used to predict or compare the building response to Concorde operations or to determine building response for community surveys.

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INTRODUCTION

Measurements of Concorde noise-induced building vibrations are being conducted by the National Aeronautics and Space Administration (NASA) for the DOT/FAA as part of the Concorde assessment program. The first study in this phase of the assessment was carried out at Sully Plantation, Chantilly, Virginia, during the period of May 20 through May 28, 1976, and reported in NASA TM X-73919 (ref. 1). A second study was conducted at Sully Plantation from June 14 to June 17, 1976, to expand the data base and the results were reported in NASA TM X-73926 (ref. 2). Sully Plantation was chosen for the first series of tests because of its close proximity to the airport (approximately 5.6 kilometers (3.5 miles) from brake release) and because of the public interest in this recently restored historical landmark. However, due to unique construction details as well as location, Sully Plantation was in many respects atypical of residences in the Dulles area. Thus, the third series of tests was designed to monitor noise and vibration response in more typical residential type homes located at various distances from the airport. Specifically, three homes in Montgomery County, Maryland were identified by the FAA as potential test sites. In each case, concern about building vibrations had been expressed by the occupants and, furthermore, the occupants were willing to offer their homes as test sites. The purpose of this series of tests, in addition to monitoring Concorde vibration, was to refine the measurement techniques so that subsequent community surveys (similar to the present

study but involving many more houses) could be carried out in an efficient manner, if necessary.

The approach being followed in the assessment of Concorde noise-induced building vibrations involves the following steps: (1) the measurement of the vibratory response of selected historic (e.g., Sully Plantation), and other buildings; (2) the development of functional relationships ("signatures") between the vibration response of building elements and the outdoor and/or indoor noise levels associated with events of interest; (3) the comparison of Concorde induced response with the response associated with other aircraft as well as common domestic events and/or criteria. If for a given structure, the vibration/noise relationships or signatures (step 2) are found to be approximately the same for all aircraft, the response of the structure to a particular aircraft noise level (e.g., Concorde) could be determined by interpolating or extrapolating the signatures generated from a very limited number of noise exposures. Such a technique would greatly expedite any large-scale surveys of building response.

This report presents a description of the test sites, details of the building construction and the location (orientation) of vibration and noise transducers. Results are presented in terms of the levels of vibration and noise associated with Concorde, other aircraft, and nonaircraft events. In addition, the noise associated with Concorde is presented in terms of several subjective units in addition to the overall sound pressure level. Finally, some subjective comments of the occupants are presented.

TEST SITE DESCRIPTION

Location

Figure 1(a) is a map showing the approximate locations of the three residential test structures which were used for the test. All of the structures are located in predominately rural areas of Montgomery County, Maryland. Their locations relative to Dulles Airport are also shown on the map.

Test structure 1.- Residential test house 1 was located on Comus Road, Clarksburg, Maryland, and was approximately 32 kilometers north-northeast from the end of Dulles runway 1L.

Test structure 2.- Residential test house 2 was located on Barnesville Road, Barnesville, Maryland, and was approximately 29 kilometers north-northeast from the end of Dulles Airport runway 1L.

Test structure 3.- Residential test house 3 was located on Wasche Road, Dickerson, Maryland, and was approximately 21 kilometers north of Dulles Airport runway 1L.

Structural Details and Instrument Locations

Test structure 1.- Figure 1(b) is a photo of the west face of the recently constructed two-story "Williamsburg" style frame structure, which is situated on a west facing slope of a knoll in wooded surroundings. A sketch of the plan view of the house is provided in figure 1(c). The house is of typical wood frame construction with the exception of styrofoam insulation which was used in lieu of weatherboard before the exterior was sheathed with redwood siding. The interior walls of the house are of

typical drywall construction and were p... i. Because the south and west sides of the house received the largest exposure to the Concorde overflights (based on information provided by the owner), the south and west facing kitchen area was chosen as the location for measuring the wall and window acceleration responses. Figure 1(d) shows the location of the accelerometer as positioned on the west wall of the kitchen. The other accelerometer was centered on the outside of the west kitchen window as shown in figure 1(e). The window pane measured 76.2 cm wide by 76.2 cm long and was of double thickness (thermopane) construction. To measure inside and outside sound pressure levels, one microphone was placed in the kitchen and one was placed in the front (west) yard clear of trees.

Test structure 2.- Figure 2(a) is a picture of the north side (front) of the 60 year old two-story frame structure situated on a north facing slope of a knoll in the rural village of Barnesville, Maryland. A sketch of the plan view of the house is provided in figure 2(b). The house is of wood frame construction with aluminum siding over wood clapboards. The interior wall studs of the house are covered with lath and plaster. The original plaster has since been covered with wallpaper. As was the case with test structure 1, information was received from the owner which determined that portion of the house which appeared to receive most of the Concorde exposures. Subsequently, the dining room was chosen as the room for locating the two accelerometers. Figure 2(c) shows the location of the accelerometer on the south wall of the dining room, behind the china closet. Another accelerometer was centered on the outside of the south dining room aluminum framed storm window as shown in figure 2(d). The storm window was of single thickness construction and measured 71.1 cm by 76.2 cm and covered a window with 16 sashings. Two microphones were used to measure inside and outside

sound pressure levels and were located in the center of the dining room and south yard which was clear of trees.

Test structure 3.- Figure 3(a) shows the west side of the one-story house located on relatively level terrain in Dickerson, Maryland, and used as test structure 3. Figure 3(b) is a sketch of the plan view of the residence. The house is of typical wood frame construction and faced with brick veneer. The interior walls are covered with wood paneling. Because the owner indicated that the west side of the house received the most exposure to Concorde overflights, the test instrumentation was located in the living room of the house. Figure 3(c) shows the location of the accelerometer as it was positioned on the west wall of the living room. Another accelerometer was centered on the outside of the aluminum framed storm window on the west living room wall as shown in figure 3(d). The storm window was of single thickness construction and measured 78.7 cm wide by 129.5 cm long and covered a picture window of equal dimensions. Two microphones were used to measure inside and outside sound pressure levels and were located in the living room near the west window and near the (west) yard in a vacant field which was clear of trees.

DATA LOG

All data measurements taken at test sites 1, 2, and 3 were recorded during the period of August 5 through August 9, 1976. Table I is a chronological listing of Concorde takeoff events during this time period that utilized runway 1L or 19L at Dulles International Airport. A total of five Concorde flights were measured at sites 1 and 2, while only four

were obtained at site 2 because the test structure was not available for use on August 8, 1976.

DATA ACQUISITION AND PROCEDURE

Instrumentation

The details of the instrumentation system are described in reference 1. The measurements made in Montgomery County, August 1976, were conducted using three instrumented vans, one of which comprised a mobile laboratory containing both an analog acquisition system and an on-line digital processing system. Acoustic measurements of interior and exterior sound pressure levels were made, as well as vibration levels of the wall and window at selected single family dwellings. Conventional Bruel and Kjaer equipment was used for the sound measurements. Piezoelectric crystal accelerometers, employing in-house developed signal conditioning, were used for the vibration measurements. All data were recorded on analog FM tape for further analysis. On-line analog x-y plots of window vibration response versus outside sound pressure level were obtained for many of the events. The primary system used for on-line acquisition consisted of a General Radio 1926 true rms log voltmeter which provided overall or magnitude values for each second on the five information channels. A Hewlett-Packard 21M20 digital computer was then used to assemble these data into tabulations of the time history values for line printing and for "Calcomp" plots of the noise and acceleration time histories as well as plots of selected acceleration levels as a function of outside sound pressure levels. Figure 4 is a block diagram of the instrument system used in this test.

Frequency Response and Calibration Procedures

In addition to extensive pretest documentation of frequency response, deviation linearities, gain accuracies and dynamic range, daily calibrations consisted of: tape recorder sensitivity (deviation) checks, pink noise (voltage) insertion in the microphone channels, one-half volt sine wave reference voltage insertion into accelerometer channels, and 250 Hz pistonphone acoustic calibration of the microphone systems for pretest and posttest as a minimum; more frequently if time permitted. Frequency response of the acoustic channels is nominally ± 1 dB over the range from approximately 5 Hz to 10 kHz and ± 1/2 dB over the range from approximately 3 Hz to in excess of 3 kHz for the accelerometer channels.

Test Procedures and Communications

Tower communications were monitored and spotters located near each house were used to identify aircraft as well as to control and coordinate data acquisition. Time code was recorded to provide a common time base for use in later analysis. All events which were not analyzed in real time with the computer were later analyzed from tape playback.

Reference Acoustic Source

An Altec Model 9844A, playback/monitor speaker system having a frequency response extending from approximately 50 Hz to 15 kHz was used as a reference noise source. The speaker system contains two 12 inch (30.48 cm) speakers and a high-frequency horn. USASI shaped noise spectra at several discrete acoustic levels (as monitored on a hand-held sound level meter) were impressed on the window and walls from the outside of each house, approximately 2 meters away while sound and vibration levels were recorded. Vibration

levels due to this USASI source are compared with vibration levels induced by Concorde and conventional aircraft operations in the next section.

PRESENTATION OF RESULTS

The approach followed in this series of tests was to examine certain of the noise/vibration relationships observed at Sully Plantation in more typical residential structures located at greater distances from the airport. Specifically, the relationships between aircraft noise levels and window and wall responses were determined for Concorde, CTOL, and nonaircraft events. In addition, measurement procedures applicable for possible future community surveys were examined. Finally, occupants and neighbors at the sites were questioned concerning their perceptions of the aircraft noise and vibration environment.

Time Histories

Overall levels of sound and vibration (no frequency weighting) have been plotted at 1-second intervals for the duration of each flyover. Figures 5 illustrate the data format. These figures describe a Concorde event at Dickerson, Maryland, some 21 kilometers north of Dulles Airport. The outdoor acoustic time history is shown on each figure as a reference, along with the time history of one of the other transducers; either the inside microphone or one of the accelerometers. Acoustic transmission losses can be determined from the outdoor/indoor sound level plots while the sound/vibration time histories reveal the correlation between sound pressure level and vibration level as well as the threshold of sound pressure level necessary to induce above ambient vibration levels in each structure for a given flyover. Printed listings for each flyover time history were also generated.

Noise Levels

Tape recordings of each Concorde flyover were further analyzed upon return to the laboratory. One-third octave band spectra were determined for the outdoor sound levels at half second intervals for the duration of each flight. Table II is an example of one such third-octave time history. These spectra were then used to generate time histories of perceived noise level, tone-corrected perceived noise level, and A-weighted sound level. An Effective Perceived Noise Level (EPNL) was also calculated for each Concorde flyover. The results of these calculations are presented in Table III. The Concorde flights are grouped according to site number (see map in figure 1) and for each flight, maximum values of overall sound level (OASPL(M)) and A-weighted sound level (dBA(M)) are given. Also displayed are EPNL values and maximum values of both perceived noise level (PNL(M)) and tone-corrected perceived noise level (PNLT(M)). Maximum tone corrections for each flight and duration correction associated with the EPNL calculations are also displayed.

Vibration Levels

The maximum window and wall vibration levels for each of the Concorde flights are shown in Table IV along with the associated OASPL values. It should be noted that the noise levels corresponding to the maximum vibration response levels may not necessarily be the maximum levels (Table III) due to diffraction effects as described in reference 1.

The vibration levels for a variety of nonaircraft events such as washing windows and closing doors are presented in Table V. As noted, the response due to certain of these events exceeded the vibration levels induced by the Concorde on both the window and wall.

Signatures

In order to quantitatively assess the relationships between aircraft noise levels and the corresponding levels of vibration induced in the windows and walls, response signatures (plots of window acceleration versus sound pressure level) were made for each flyover which exceeded the ambient. Data obtained at the three sites are presented in figures 6(a) through (f). In addition, the response to the USASI noise is presented. As noted, all of these sources cluster about a faired line which to a first approximation would appear to be independent of source differences. The fact that the speaker system closely simulated the aircraft induced-response suggests that this reproduction technique could be used as a standard for determining house response characteristics for a given noise level or for comparing with subjective responses.

Subjective Comments

This series of tests was guided more by subjective considerations than the previous tests at Sully Plantation which were concerned primarily with building damage. Consequently, the selection of test sites, the house construction details, and the test techniques for this series of tests were aimed at responding to concerns of the occupants. To gain better insight into the concerns of the residents, the occupants as well as neighbors in the area were encouraged to discuss their perceptions as to the noise and vibration environment in their area. It was interesting to note that all of the occupants perceived structural vibrations, however, none of the occupants (in response to a question concerning secondary vibrations, see ref. 3) perceived rattles of pictures, china, etc. Representative comments are listed below:

o We are not particularly against the Concorde. We think it is a beautiful airplane.

o The Concorde is awful. Why do they let it fly?

o It (the Concorde) sounds different than other aircraft and the noise is louder and persists for a much longer time. The air seems to vibrate all around.

o One Concorde flight a day is not too bad, but we are concerned that many additional flights would be too much noise.

o The noise frightens the baby.

o The house vibrates or is "jarred" sometimes when the Concorde goes over.

o We do not think it is loud enough to damage the house, but what does it do to people's hearing?

o We can hear the Concorde even with the television and air-conditioner on.

o Vibration occurs on the side of the house in the kitchen area.

CONCLUDING REMARKS

Noise-induced building vibrations were monitored at three test sites in Montgomery Country, Maryland, ranging from 21 to 32 kilometers from Dulles International Airport. Accelerometers were mounted on windows and wall surfaces and microphones were located both inside and outside of the houses. Noise and vibration levels were monitored for several Concorde and CTOL departures as well as several nonaircraft events at each site. Results suggest the following:

1. The response of the windows and walls appear to be directly

proportional to the sound pressure level of the aircraft noise and virtually independent of aircraft type. The windows exhibited higher response levels than the walls.

2. Concorde operations resulted in higher noise levels and, consequently, higher vibratory response levels than CTOL aircraft.

3. The response characteristics of the windows and walls (ACL versus SPL signatures) at each site could be closely reproduced by playing (USASI) aircraft noise through a speaker system located near the vibration measurement location. It thus appears that a taped aircraft sound source could be used as a standard for determining or comparing window/wall response characteristics and/or comparing with subjective survey data.

4. Nonaircraft events such as closing doors and washing windows resulted in response levels equal to or higher than those associated with Concorde operations.

5. Additional studies may be required to develop a comparative data base illustrating response differences between houses and illustrating the correlations between building response and subjective reactions.

REFERENCES

1. Staff-Langley Research Center: Concorde Noise-Induced Building Vibrations for Sully Plantation, Chantilly, Virginia. NASA TM X-73919, June 1976.

2. Staff-Langley Research Center: Concorde Noise-Induced Building Vibrations, Sully Plantation - Report No. 2, Chantilly, Virginia, NASA TM X-73926, June 1976.

3. Carden, Huey D.; and Mayes, William H.: Measured Vibration Response Characteristics of Four Residential Structures Excited by Mechanical and Acoustical Loadings. NASA TN D-5776, April 1970.

TABLE I.- CONCORDE OPERATIONS LOG

Site	Event No.	Day August 1976	Approx. Time, p.m.
1	101	5	1:06
	102	6	1:07
	108	7	1:16
	124	8	12:57
	130	9	1:06
2	407	5	1:06
	429	6	1:06
	438	7	1:16
	473	9	1:05
3	607	5	1:05
	628	6	1:03
	635	7	1:15
	665	8	12:55
	673	9	1:04

TABLE II.- ONE-THIRD OCTAVE SPECTRA OF CONCORDE TAKEOFF

(EVENT 665 AT SITE 7)

Time, half-sec intervals

One-third octave center freq.

K	OASPL	50	63	80	100	125	160	200	250	315	400	500	630	800	1K	1.25	1.6	2.0	2.5	3.15	4.0	5.0	6.3	8.0	10K
1	89.2	70.3	78.3	74.6	72.7	71.0	65.5	66.5	76.2	84.6	84.0	78.5	77.3	71.4	71.0	66.6	63.3	59.1	54.7	49.8	50.0	51.0	50.7	50.7	51.5
2	89.9	72.2	75.0	71.1	69.7	71.6	72.0	66.6	78.2	84.6	82.2	82.0	80.3	74.1	75.5	72.1	64.6	59.3	55.0	49.8	50.0	51.0	50.7	50.7	51.5
3	92.1	72.4	76.0	77.1	72.2	70.4	72.0	66.1	78.7	86.3	87.7	82.5	79.0	75.9	75.2	72.6	69.1	61.6	56.2	50.5	50.0	51.0	50.7	50.7	51.5
4	90.2	73.7	72.0	72.6	74.4	71.6	70.7	63.1	77.0	85.1	85.5	82.3	73.0	68.6	68.2	65.3	61.3	57.1	53.2	49.5	50.0	51.0	50.7	50.7	51.5
5	95.3	70.7	75.3	71.1	71.2	71.5	68.2	64.9	75.0	89.6	92.2	86.0	75.0	75.4	73.0	68.0	65.1	63.1	57.5	52.0	51.0	53.0	51.5	50.7	51.5
6	94.3	70.9	75.0	76.4	75.4	73.1	72.2	68.1	79.7	89.5	89.7	86.8	78.0	80.6	74.0	68.1	65.0	63.3	58.7	52.8	52.0	54.5	55.0	50.7	51.5
7	94.4	70.7	71.5	74.6	75.4	72.5	71.2	67.6	88.0	90.3	90.0	83.5	77.0	80.1	71.2	71.1	66.1	61.0	58.0	52.5	52.2	54.5	55.0	50.7	51.5
8	96.7	72.9	75.0	73.4	73.9	71.4	69.5	68.4	83.7	92.0	91.7	83.3	83.5	83.9	80.7	77.0	75.1	71.1	64.0	58.0	53.5	53.5	52.0	50.7	51.5
9	96.9	72.2	74.0	75.1	71.2	68.6	66.5	69.1	84.0	91.0	91.7	86.0	86.5	85.9	81.9	76.6	75.6	68.8	63.7	59.0	53.7	51.0	50.7	50.7	51.5
10	93.6	71.4	69.5	73.1	72.2	69.4	63.2	68.6	82.7	85.1	88.7	70.5	82.0	79.6	78.5	74.3	71.0	69.8	63.8	59.0	53.7	51.0	50.7	50.7	51.5
11	94.0	71.9	78.0	73.4	72.2	68.1	63.8	74.1	83.8	90.6	87.2	88.0	83.0	79.4	75.0	75.8	71.3	69.8	64.5	58.5	53.7	51.0	50.7	50.7	51.5
12	95.6	72.2	72.5	73.4	71.7	68.9	66.0	76.1	86.0	91.0	89.5	83.0	83.0	88.1	76.7	77.1	73.0	70.0	67.2	63.3	50.0	52.5	50.7	50.7	51.5
13	92.7	70.7	75.0	78.1	70.4	62.6	68.0	76.4	82.7	88.3	84.5	83.3	82.0	88.6	77.0	74.3	71.6	70.1	66.2	68.3	56.0	51.0	50.7	50.7	51.5
14	94.2	73.7	74.8	71.1	68.9	64.4	70.2	76.6	84.7	88.8	86.5	86.0	83.3	83.1	79.5	76.0	75.3	73.1	69.0	65.5	60.7	55.7	50.7	50.7	51.5
15	96.5	74.4	74.0	73.4	69.9	66.9	70.5	78.6	86.0	87.1	87.7	92.3	83.0	86.6	82.7	79.1	78.6	77.1	75.0	70.5	65.2	60.7	54.7	50.7	51.5
16	96.7	78.2	74.0	72.1	67.4	60.6	74.5	88.9	86.7	85.8	90.0	91.0	83.3	86.1	83.2	81.0	80.6	78.0	75.7	72.0	69.2	64.5	55.2	53.2	51.7
17	97.4	76.2	74.0	71.6	68.2	70.4	74.7	88.9	85.0	83.3	92.7	91.5	85.0	85.9	84.0	81.1	79.1	78.6	75.0	72.3	68.0	63.0	56.7	51.7	51.5
18	99.2	75.7	74.5	68.6	66.7	73.9	78.5	82.9	85.7	84.3	95.5	92.8	88.0	86.4	84.7	83.3	81.3	75.6	77.2	75.3	71.5	68.6	61.5	55.2	53.8
19	97.9	72.4	71.0	71.6	65.4	73.1	70.0	81.1	82.2	85.3	94.7	89.5	87.3	85.9	85.5	81.3	79.6	77.6	76.0	72.3	69.2	66.7	61.2	55.2	52.5
20	98.3	74.2	74.0	71.1	66.2	74.6	75.7	82.9	83.0	86.3	94.2	89.0	88.3	87.4	85.5	83.6	82.1	79.6	78.5	76.3	74.0	72.5	69.0	62.2	59.0
21	101.	71.9	75.5	60.4	67.4	76.6	80.0	84.4	81.0	89.3	96.7	94.3	90.5	90.4	89.2	86.3	84.0	82.1	80.7	79.0	77.2	72.5	68.0	61.9	57.5
22	100.	75.2	72.3	67.1	71.5	70.9	84.0	82.4	78.5	90.0	93.5	94.5	88.5	88.4	89.0	86.1	84.6	82.0	81.7	75.5	76.7	72.7	67.2	61.7	54.7
23	102.	73.4	72.5	70.4	71.2	79.1	82.7	83.9	79.2	91.6	93.7	97.0	93.0	91.1	89.2	88.3	86.1	84.0	83.7	82.0	79.2	75.5	70.0	65.9	60.2
24	102.	75.2	73.5	68.6	75.9	78.6	83.5	85.1	78.5	89.1	98.0	97.0	94.0	98.1	90.5	88.1	86.0	83.6	81.7	79.0	76.0	72.7	67.2	61.7	57.7
25	104.	72.9	60.3	69.6	77.4	84.1	86.0	84.1	81.0	90.6	91.2	97.0	97.0	95.6	93.0	91.6	88.1	87.6	84.7	82.3	80.5	80.5	77.7	71.9	64.5
26	101.	76.2	66.5	87.1	78.9	82.6	85.2	83.4	80.5	88.1	98.0	93.0	94.0	92.4	89.2	85.0	85.6	85.1	82.0	80.0	75.7	72.5	60.0	62.2	58.2
27	102.	75.9	73.5	72.9	79.9	85.4	86.2	83.1	85.2	89.6	98.7	94.0	95.3	94.1	92.0	89.0	87.6	86.1	83.0	81.5	77.2	77.0	71.2	65.9	61.5
28	100.	75.2	70.0	72.1	70.9	83.6	86.5	82.6	87.0	89.6	90.2	90.0	94.0	91.9	89.0	88.6	87.1	84.6	80.7	77.0	76.5	71.5	66.7	60.7	56.7
29	99.0	77.4	69.0	74.9	80.4	87.1	87.7	83.1	87.7	88.6	88.7	88.5	91.3	90.6	89.2	89.1	87.3	85.6	81.7	78.0	76.2	73.0	67.7	62.2	58.5
30	99.9	72.4	71.5	71.9	81.2	87.9	88.0	82.1	89.6	88.8	89.2	88.5	91.8	92.1	88.5	86.3	87.3	85.1	80.7	79.0	75.5	72.5	67.5	61.2	55.2
31	99.4	72.2	70.5	74.9	83.4	86.1	89.2	81.1	87.2	88.1	89.0	87.8	89.3	90.9	83.5	85.0	86.0	83.1	81.0	79.6	76.0	72.5	67.7	62.4	57.5
32	101.	76.2	72.0	73.4	81.4	90.1	91.2	83.9	91.0	85.8	91.7	90.0	90.0	89.9	89.0	87.6	86.3	84.1	80.5	78.0	75.7	72.5	68.0	63.2	59.0
33	102.	77.2	71.0	77.1	85.2	93.4	94.2	87.1	91.0	93.1	93.5	98.5	92.0	95.9	88.0	87.0	85.3	82.6	80.2	78.5	76.0	73.0	68.7	68.2	56.5
34	103.	80.7	72.5	78.9	88.7	93.4	92.0	87.4	94.2	94.6	93.5	93.0	93.0	91.4	88.7	88.6	86.0	85.1	80.7	78.5	75.5	73.0	68.7	62.7	57.2
35	104.	88.9	73.0	76.4	89.4	94.6	95.5	90.1	92.7	93.3	93.7	93.3	93.0	90.9	89.2	89.6	86.3	85.1	82.2	80.3	77.0	73.0	71.2	62.9	60.7
36	103.	88.7	77.0	81.1	89.4	95.0	95.0	90.6	93.2	93.0	92.5	92.0	90.5	89.9	86.7	87.6	85.0	84.1	80.5	75.0	75.5	72.2	66.5	60.9	58.2
37	105.	81.9	79.3	82.4	92.2	97.9	98.2	91.4	93.8	95.3	92.5	92.8	92.5	90.9	88.8	89.3	86.1	83.1	80.7	78.3	76.0	73.7	70.2	65.4	62.7
38	106.	81.9	81.5	84.9	93.4	97.4	99.2	95.5	93.2	96.0	91.5	92.3	92.0	91.9	89.0	87.0	84.3	81.6	75.7	70.0	74.2	71.2	68.0	64.9	60.0
39	107.	87.2	83.5	83.4	92.4	101.	101.	97.1	92.7	97.1	92.0	94.0	92.0	91.9	89.0	87.1	84.1	82.1	80.2	77.5	75.5	73.0	68.5	63.4	62.0
40	106.	84.4	86.0	84.4	92.9	99.4	99.5	96.4	91.5	97.1	92.7	94.5	94.5	91.4	90.2	89.1	86.6	83.1	83.0	75.0	75.7	74.0	72.5	65.4	61.7
41	106.	83.4	83.3	84.1	94.7	98.9	100.	95.4	98.2	96.6	91.5	93.3	91.0	90.4	80.7	86.6	85.3	83.6	82.7	75.0	78.5	73.2	72.0	66.4	62.7
42	105.	87.7	85.5	85.1	93.4	97.4	100.	95.1	89.0	94.6	91.2	90.0	89.0	87.6	84.5	85.8	83.8	81.6	81.0	78.0	76.7	72.5	66.5	60.9	57.5
43	105.	88.7	84.0	84.4	91.7	97.9	100.	96.1	87.7	94.0	89.0	91.8	85.5	84.9	85.5	82.1	82.1	80.6	79.0	78.0	78.0	73.5	68.0	63.7	57.2
44	106.	91.7	89.0	86.1	90.4	96.9	99.2	98.9	98.2	97.6	93.5	94.5	91.5	88.4	84.2	84.1	83.6	82.1	81.2	79.0	76.5	74.5	71.0	67.7	65.2
45	105.	91.4	91.0	87.9	88.9	96.4	98.2	97.1	98.0	95.1	92.0	92.8	88.8	85.4	82.0	79.3	79.3	77.0	77.2	75.5	72.8	69.5	64.7	62.2	58.0
46	104.	87.9	90.5	84.0	87.9	91.4	97.2	97.1	92.7	94.1	93.0	91.0	89.8	88.6	85.0	80.5	79.6	79.1	77.2	74.0	70.2	67.2	62.7	55.9	54.2
47	104.	91.4	88.3	81.9	84.4	92.6	97.0	97.1	98.7	91.6	92.2	91.5	89.0	87.9	86.7	83.1	80.1	77.1	74.5	72.8	68.5	62.7	50.7	53.4	53.0
48	104.	90.2	89.5	84.1	84.4	91.1	98.0	97.6	93.0	90.0	92.2	88.5	87.0	85.6	83.0	80.6	76.0	74.5	73.7	70.5	66.2	62.5	58.2	53.4	53.0
49	104.	90.4	89.0	86.9	83.4	91.9	95.2	97.6	94.2	93.1	96.0	89.3	89.5	87.6	84.0	82.6	77.3	75.6	74.2	71.5	68.2	64.2	59.2	54.4	53.0
50	105.	97.2	91.5	85.9	84.2	90.6	95.5	96.9	97.0	93.1	96.7	91.0	91.5	91.1	87.2	84.3	79.1	75.3	72.5	71.3	67.2	62.7	57.5	53.7	52.5
51	105.	89.4	88.3	84.9	85.9	90.6	96.7	99.6	90.0	98.3	90.7	89.0	90.0	90.1	86.5	85.6	80.1	74.3	72.5	70.0	66.0	62.0	57.5	53.2	52.5
52	103.	87.2	89.3	87.1	82.7	87.9	95.0	96.9	95.2	87.1	90.5	86.0	87.0	83.6	82.5	80.3	79.3	73.3	69.0	66.0	62.5	58.2	52.7	50.7	52.5
53	102.	84.4	88.3	85.1	83.4	88.6	90.0	93.9	94.0	85.6	93.2	89.0	87.5	85.1	83.5	80.6	79.6	75.6	71.2	68.0	63.8	60.2	54.2	51.4	52.2
54	99.3	85.7	87.3	85.4	83.2	86.6	89.0	93.9	93.2	82.3	88.5	83.5	77.0	77.1	75.7	75.8	74.3	71.0	68.5	62.5	59.0	58.0	55.2	50.7	52.0
55	98.6	86.9	87.0	85.1	79.4	82.4	88.5	93.1	92.0	81.6	87.2	84.0	80.0	78.9	70.0	73.1	72.1	69.8	66.2	62.5	58.5	55.7	54.2	50.7	51.5
56	98.3	86.7	86.0	82.6	78.9	84.6	88.2	91.9	91.7	81.6	88.0	86.0	82.0	79.6	79.2	76.3	74.0	72.1	68.0	64.3	59.0	56.2	53.7	50.7	51.5
57	98.1	85.4	86.5	82.9	77.9	80.6	87.5	92.9	91.7	85.1	87.2	84.0	78.0	74.9	73.7	72.6	72.1	65.3	64.2	61.0	55.7	51.0	50.7	50.7	51.5
58	98.3	89.2	86.3	82.4	81.2	82.9	87.0	90.6	92.5	88.0	86.2	83.5	78.0	78.1	76.0	71.6	71.1	68.1	64.7	59.0	55.0	51.0	50.7	50.7	51.5
59	97.0	89.7	86.5	85.1	77.9	79.9	84.0	88.1	90.6	86.8	82.7	84.5	79.3	76.9	76.0	73.1	74.1	70.1	64.2	58.3	54.7	51.0	50.7	50.7	51.5
60	96.5	89.2	85.5	88.4	78.9	77.9	85.7	89.9	90.0	85.3	78.2	81.0	76.8	76.1	73.5	70.1	68.8	66.0	63.2	59.5	53.8	51.0	50.7	50.7	51.5
61	96.2	89.9	86.3	83.1	81.4	79.4	85.0	86.1	89.2	85.6	80.5	82.0	77.5	76.6	73.2	70.0	69.1	67.0	63.5	60.5	53.7	51.0	50.7	50.7	51.5
62	96.7	88.4	84.0	83.9	81.2	79.6	85.5	89.4	90.7	87.1	79.0	79.5	77.0	78.4	75.5	70.3	66.0	65.6	61.2	58.0	53.5	51.0	50.7	50.7	51.5
63	97.7	89.9	85.0	83.4	80.7	79.4	85.7	89.1	92.2	88.1	79.2	84.0	77.5	80.6	76.0	72.6	69.3	67.1	65.0	59.5	56.0	51.0	50.7	50.7	51.5
64	98.4	89.4	86.0	86.6	79.9	79.9	84.2	91.6	93.0	89.3	81.0	81.0	76.0	76.6	74.0	69.6	67.0	64.0	62.7	57.0	52.2	51.0	50.7	50.7	51.5
65	95.5	88.4	88.5	85.1	81.7	75.4	88.0	87.4	86.5	83.6	76.0	80.0	77.5	76.0	74.0	71.1	67.1	64.1	59.5	56.0	50.2	51.0	50.7	50.7	51.5
66	94.6	86.7	87.3	84.9	79.9	75.4	76.5	83.6	85.0	83.1	74.5	81.0	78.0	77.4	72.7	68.3	64.6	62.3	56.2	53.3	50.0	51.0	50.7	50.7	51.5
67	94.3	87.2	84.0	82.6	79.9	76.9	75.5	84.6	88.0	85.1	76.5	77.0	78.0	76.9	71.5	66.0	63.3	59.1	54.2	50.3	50.0	51.0	50.7	50.7	51.7
68	95.0	88.7	85.0	78.9	77.2	78.1	75.7	84.4	89.2	87.3	78.7	78.0	77.5	72.1	69.2	66.6	64.3	61.1	53.7	49.5	50.0	51.0	50.7	50.7	51.5
69	94.6	85.2	85.0	81.6	78.7	76.4	77.0	84.6	88.7	85.0	79.7	88.3	82.0	77.9	74.5	73.1	67.0	63.0	56.5	49.5	50.0	51.0	50.7	50.7	51.5
70	94.2	86.4	86.3	83.4	77.7	76.4	74.5	84.4	87.2	85.1	78.0	78.0	79.0	76.6	73.7	72.6	69.6	65.1	67.0	53.5	50.0	51.0	50.7	50.7	51.5
71	93.7	85.2	84.0	83.4	79.4	76.6	71.7	80.9	88.0	86.3	78.7	77.3	78.9	73.1	69.7	66.0	62.6	58.0	54.0	49.5	50.0	51.0	50.7	50.7	51.5
72	92.4	85.7	83.0	82.9	77.4	73.9	71.0	80.4	84.2	84.0	77.7	73.5	76.0	69.1	66.7	63.6	59.6	55.6	50.5	49.5	50.0	51.0	50.7	50.7	51.5
73	91.5	83.7	83.5	83.1	78.7	72.1	65.7	77.9	84.2	83.6	76.5	71.0	73.5	65.1	66.5	60.6	58.3	53.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
74	91.4	82.2	82.0	81.1	79.9	75.6	69.0	77.6	84.7	84.6	70.3	71.0	74.5	68.4	67.7	63.0	57.6	54.1	49.2	49.5	50.0	51.0	50.7	50.7	51.5
75	91.7	86.2	82.0	80.9	78.9	74.9	69.5	77.9	83.0	84.6	77.7	68.3	72.5	65.9	67.5	63.3	57.1	53.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
76	90.2	83.9	81.3	81.6	80.2	72.4	78.5	75.1	81.5	81.1	74.7	69.0	73.5	66.9	67.7	61.0	56.3	51.3	49.2	49.5	50.0	53.2	54.5	50.7	51.5
77	90.0	86.7	82.0	79.4	76.5	73.6	78.0	72.4	80.5	82.1	77.2	78.0	76.3	65.9	67.2	63.6	59.3	55.3	49.2	49.5	50.0	52.5	53.5	50.7	51.5
78	88.0	82.9	79.0	81.4	75.9	70.6	68.0	72.1	79.2	80.3	74.5	68.5	71.5	65.6	62.7	56.0	52.3	49.6	49.2	49.5	50.0	52.0	52.2	50.7	51.5
79	88.0	82.2	82.0	79.9	75.7	71.4	66.7	72.1	76.5	77.1	74.0	66.0	68.0	63.6	61.5	56.1	51.0	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
80	86.4	80.2	77.0	80.4	75.4	73.4	68.5	72.1	75.5	74.0	70.0	64.3	65.9	60.4	60.0	55.6	50.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
81	87.1	82.7	80.0	79.1	74.2	72.4	66.7	71.1	73.5	76.1	70.7	64.0	63.0	55.1	58.5	53.7	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
82	88.0	82.2	80.3	81.4	77.7	74.4	69.7	70.6	76.5	76.6	72.7	64.0	63.0	55.5	58.0	54.1	49.8	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
83	88.9	84.4	81.6	80.4	77.9	73.9	69.7	73.9	77.0	76.3	71.5	65.3	63.3	59.1	55.0	52.6	50.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
84	87.5	80.9	81.3	81.4	77.2	74.4	69.5	72.4	74.7	72.6	67.2	62.0	60.3	57.4	53.5	50.6	49.6	49.6	49.2	3.5	50.0	51.0	50.7	50.7	51.5
85	90.2	85.7	83.3	83.6	80.2	75.1	70.7	71.4	73.5	75.6	65.7	60.3	62.5	61.1	53.7	52.3	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
86	89.3	84.4	83.0	80.6	78.9	75.9	71.2	71.4	74.7	75.8	69.2	61.0	64.8	65.4	55.7	53.3	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
87	89.0	82.4	83.5	81.1	77.2	74.4	72.7	71.9	75.7	78.6	74.7	66.5	62.8	62.9	57.2	54.1	50.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
88	88.3	82.4	83.3	79.6	74.7	70.4	69.2	70.9	74.2	77.0	76.0	68.0	63.8	60.9	54.7	53.1	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
89	86.2	80.2	79.0	75.9	74.9	74.1	68.2	69.4	74.7	76.6	72.5	67.3	61.3	60.6	54.2	51.6	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
90	86.6	80.4	82.0	76.4	73.7	71.6	67.7	69.9	74.0	76.1	71.5	65.0	59.8	60.1	55.0	50.6	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
91	85.5	80.9	79.0	76.6	74.9	73.1	67.2	66.9	71.5	72.8	69.0	64.0	59.8	57.1	52.8	50.1	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
92	85.0	79.7	81.3	77.1	75.7	72.4	68.2	67.1	69.7	70.1	68.7	64.5	55.9	54.4	50.5	50.1	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
93	86.5	79.2	83.3	76.9	75.4	73.6	70.2	66.6	67.5	70.1	68.7	63.5	55.5	56.4	51.2	50.1	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
94	85.0	80.4	80.3	77.0	75.4	73.6	70.2	67.9	68.7	70.1	69.5	65.0	58.0	56.6	52.5	53.6	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
95	86.0	81.9	81.3	76.1	73.7	70.1	68.0	60.9	68.2	69.6	68.5	64.5	58.8	55.4	52.2	50.3	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
96	85.7	81.7	80.3	78.1	73.4	69.4	69.8	64.9	65.0	65.6	65.7	61.8	54.5	54.1	50.5	50.1	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
97	84.8	77.9	81.5	74.6	74.2	72.9	67.7	61.1	64.0	66.6	65.5	60.5	53.3	53.1	50.5	50.1	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
98	83.5	78.2	78.3	75.6	72.4	72.4	65.7	61.6	64.8	67.8	65.7	59.3	52.8	52.6	50.5	50.1	49.6	49.6	49.2	49.5	50.0	51.0	50.7	50.7	51.5
99	83.7	70.7	76.8	75.6	74.4	78.6	67.2	66.1	64.5	65.1	62.8	56.5	50.5	50.9	50.5	50.1	49.6	49.6	49.2	49.5	50.0	52.0	53.0	50.7	51.5

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TABLE III.- CONCORDE NOISE MEASUREMENTS

Site	Event	OASPL(M)	DBA(M)	PNL(M)	PNLT(M)	DUR. COR.	TONE COR.	EPNL
1	101	93.1	85.6	96.2	97.3	2.6	1.8	99.9
	102	86.5	79.5	91.4	92.2	2.9	1.8	95.1
	108	81.2	69.6	83.4	84.5	0.9	1.8	85.4
	124	80.4	74.9	87.0	87.7	0	2.1	87.7
	130	91.6	81.0	94.5	95.2	2.4	2.3	97.6
2	407	89.5	79.9	94.4	95.4	2.6	1.7	98.0
	429	93.0	84.0	97.2	98.1	1.8	2.2	[illegible]9
	438	77.4	70.1	83.3	83.8	2.8	1.7	86.6
	473	99.7	91.4	103.5	104.0	2.4	1.8	106.4
3	607	96.8	87.4	101.3	102.1	1.9	1.7	104.0
	628	88.1	79.1	92.0	93.3	3.1	1.7	96.4
	635	91.6	86.1	96.4	97.2	2.7	2.7	99.9
	665	106.4	100.6	112.0	112.8	0.3	2.0	113.1
	673	98.4	91.0	103.3	103.9	2.5	2.1	106.4

TABLE IV.- MAXIMUM VALUES OF CONCORDE TAKEOFF VIBRATION RESPONSE MEASUREMENTS

Site	Event	Exterior Overall SPL, dB*	OA Acceleration, g_{rms}	
			Window	Wall
1	101	84.7	.060	.018
	102	79.0	.034	.010
	108	72.6	.004	.004
	124	80.0	.032	.006
	130	84.6	.064	.027
2	407	80.0	.008	.005
	429	84.7	.018	.007
	438	73.3	.006	.004
	473	92.0	.071	.020
3	607	93.3	---	.015
	628	89.0	.032	.008
	635	87.5	.020	.011
	665	105.4	.120	.034
	673	97.3	.040	.017

*SPL values correspond to max vibration level and do not necessarily represent max recorded SPL values.

TABLE V.- MAXIMUM VALUES OF VIBRATION RESPONSE DUE TO SPECIAL EVENTS

Activity	Site	Event	OA SPL, dB Ext.	OA SPL, dB Int.	Max OA ACL, grms Window	Max OA ACL, grms Wall
window washing	1	103	NA	NA	.168	.005
window washing	1	104	NA	NA	.037	.003
window washing	2	416	NA	NA	.093	.003
window washing	3	621	NA	NA	.095	.012
chairs moving	1	106	NA	NA	.007	.004
chairs moving	1	107	NA	NA	.010	.005
indoor walking	2	418	NA	NA	.004	.003
indoor walking	3	623	NA	NA	.010	.013
piano playing	1	115	NA	75	.018	.009
truck passing	2	471	73.8	62.8	.004	.003
door closing	1	105	NA	NA	.130	.120
* door closing	2	417	NA	NA	.160	.050
door closing	3	672	NA	NA	.700	.900
window closing	2	420	NA	NA	>1.000	.200

*Peak acceleration level, g's.

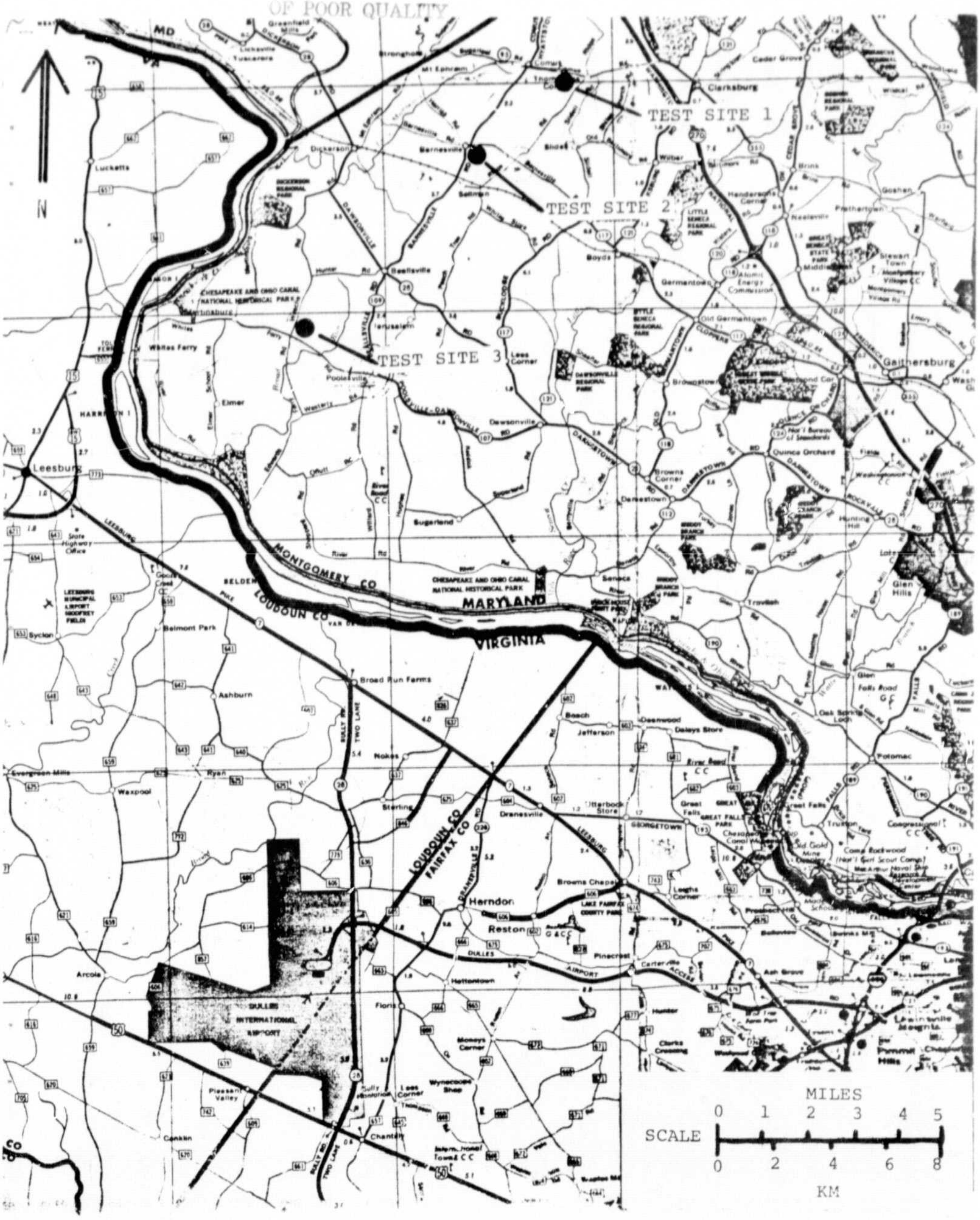

Figure 1(a). Structural vibration test site locations.

Figure 1(b). West elevation view of test structure 1.

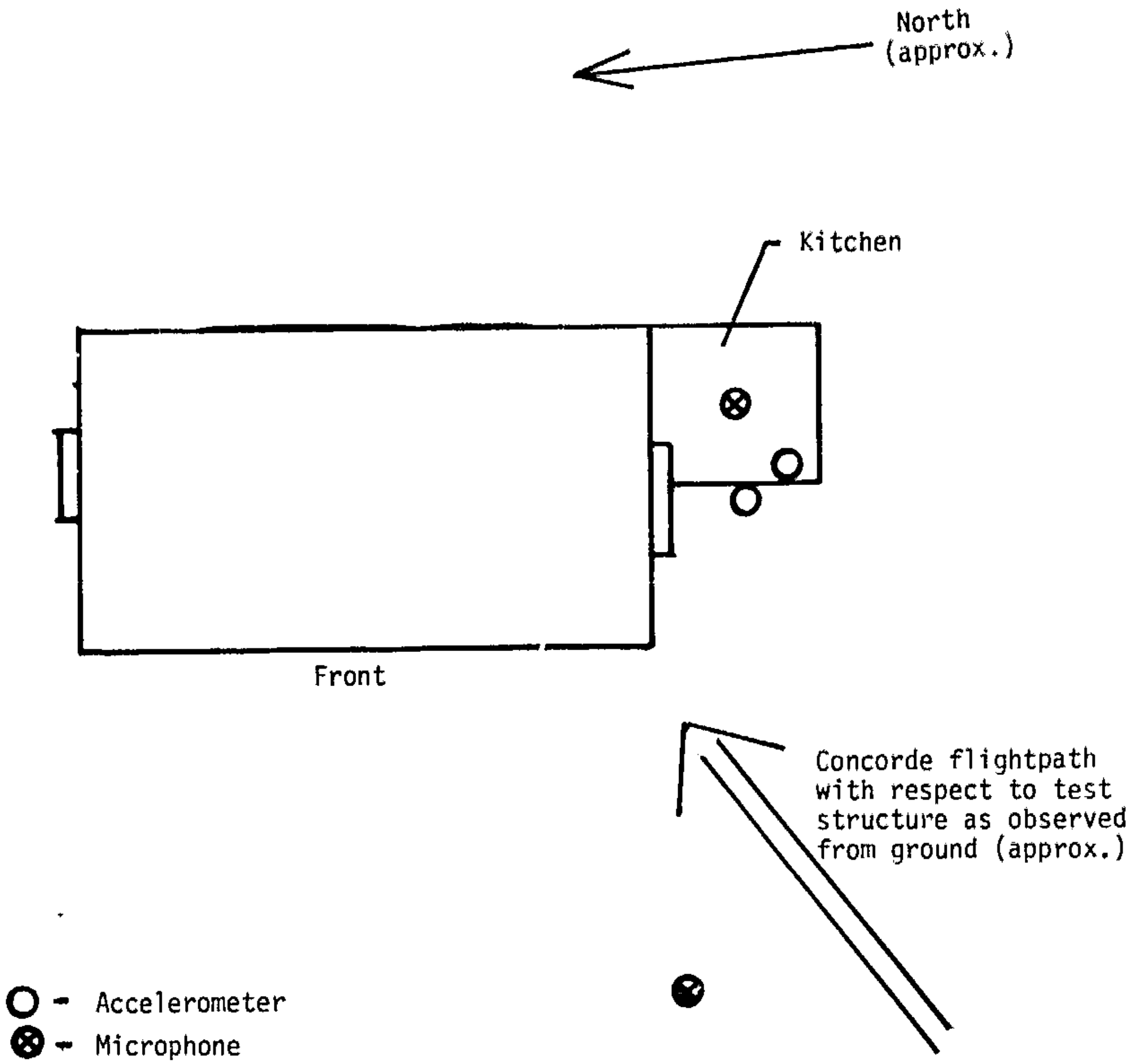

Figure 1(c). Plan view sketch of test structure 1.

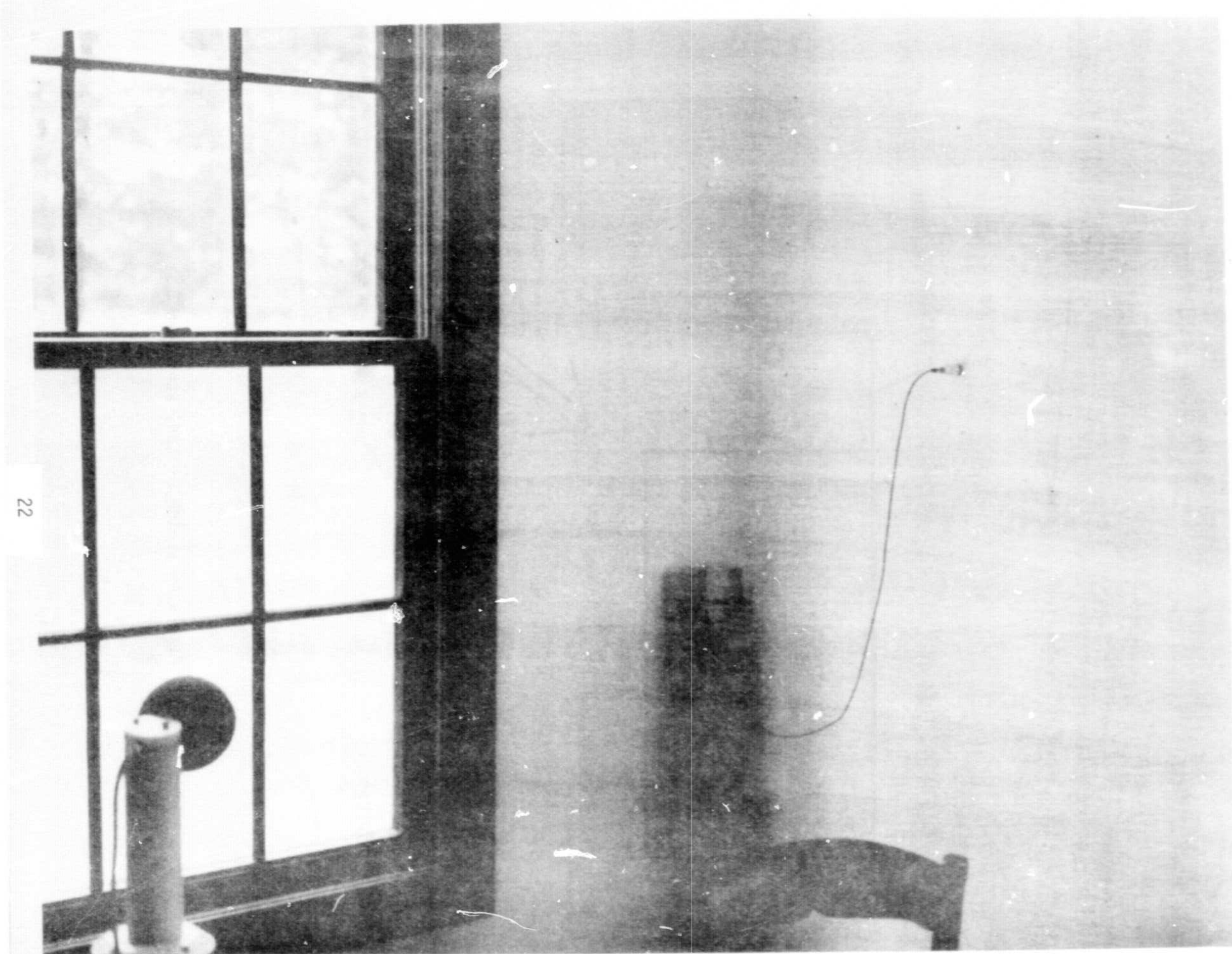

Figure 1(d). Location of accelerometer for wall vibration measurements. Site 1.

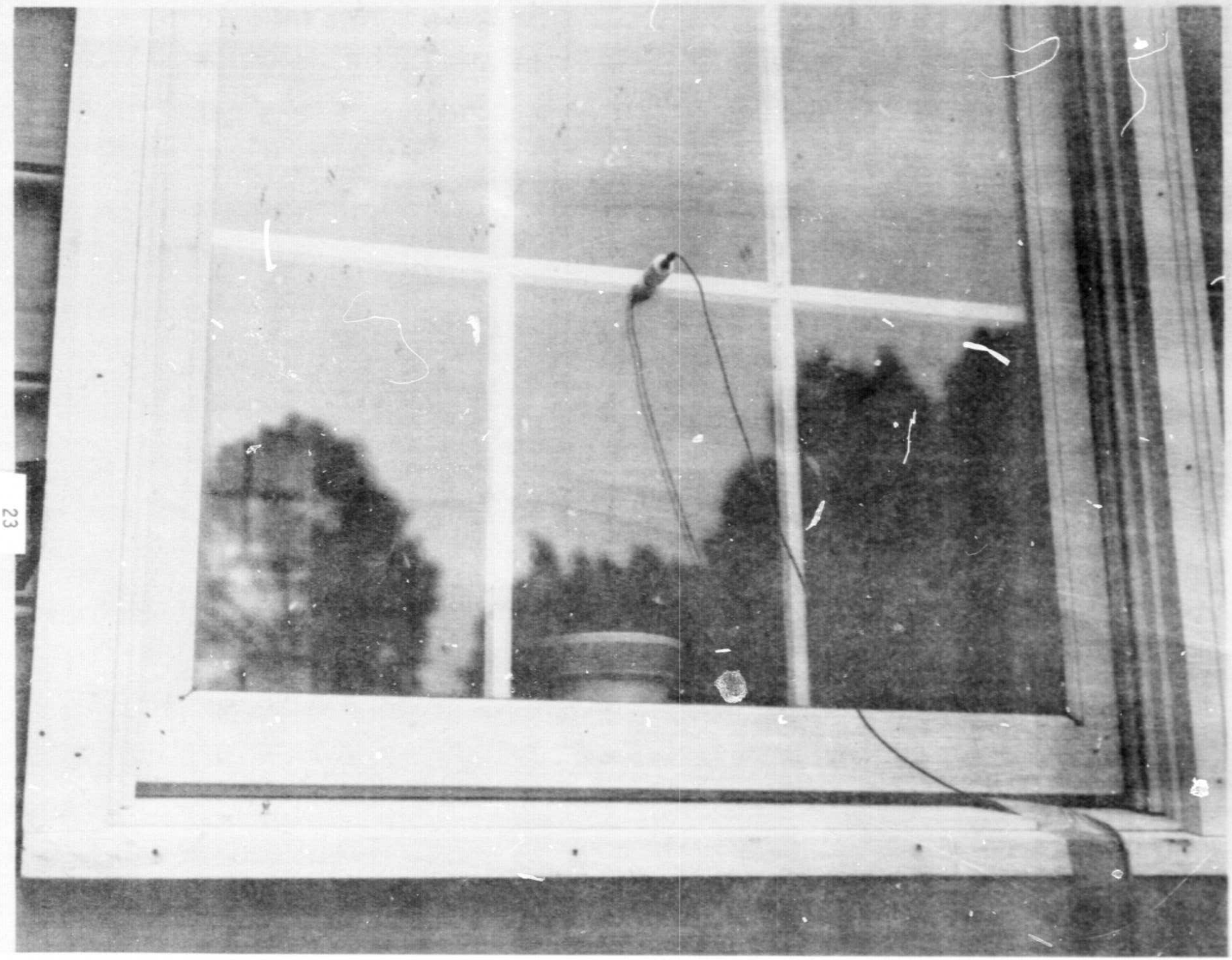

Figure 1(e). Location of accelerometer for window vibration measurements. Site 1.

Figure 2(a). North elevation view of test structure 2.

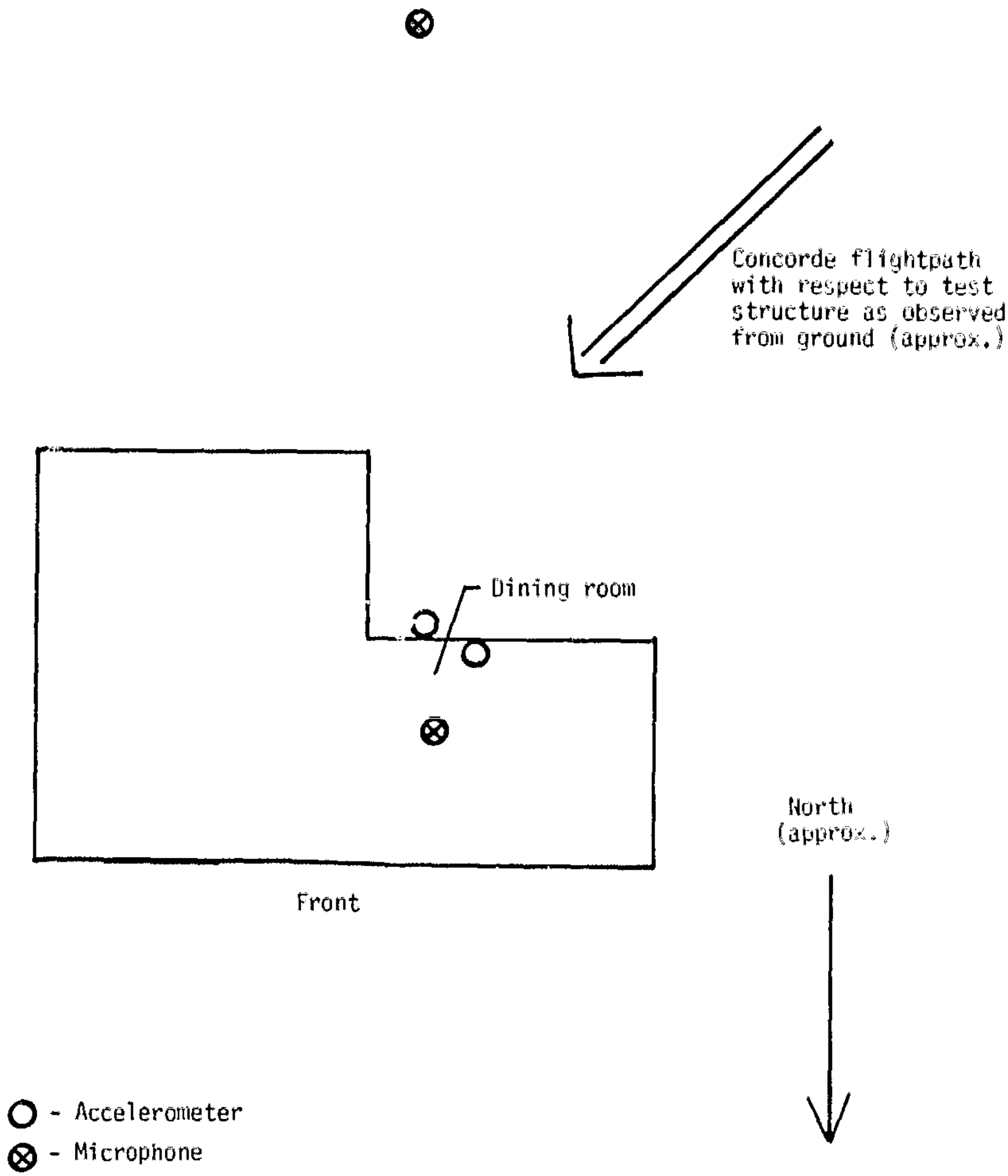

Figure 2(b). Plan view sketch of test structure 2.

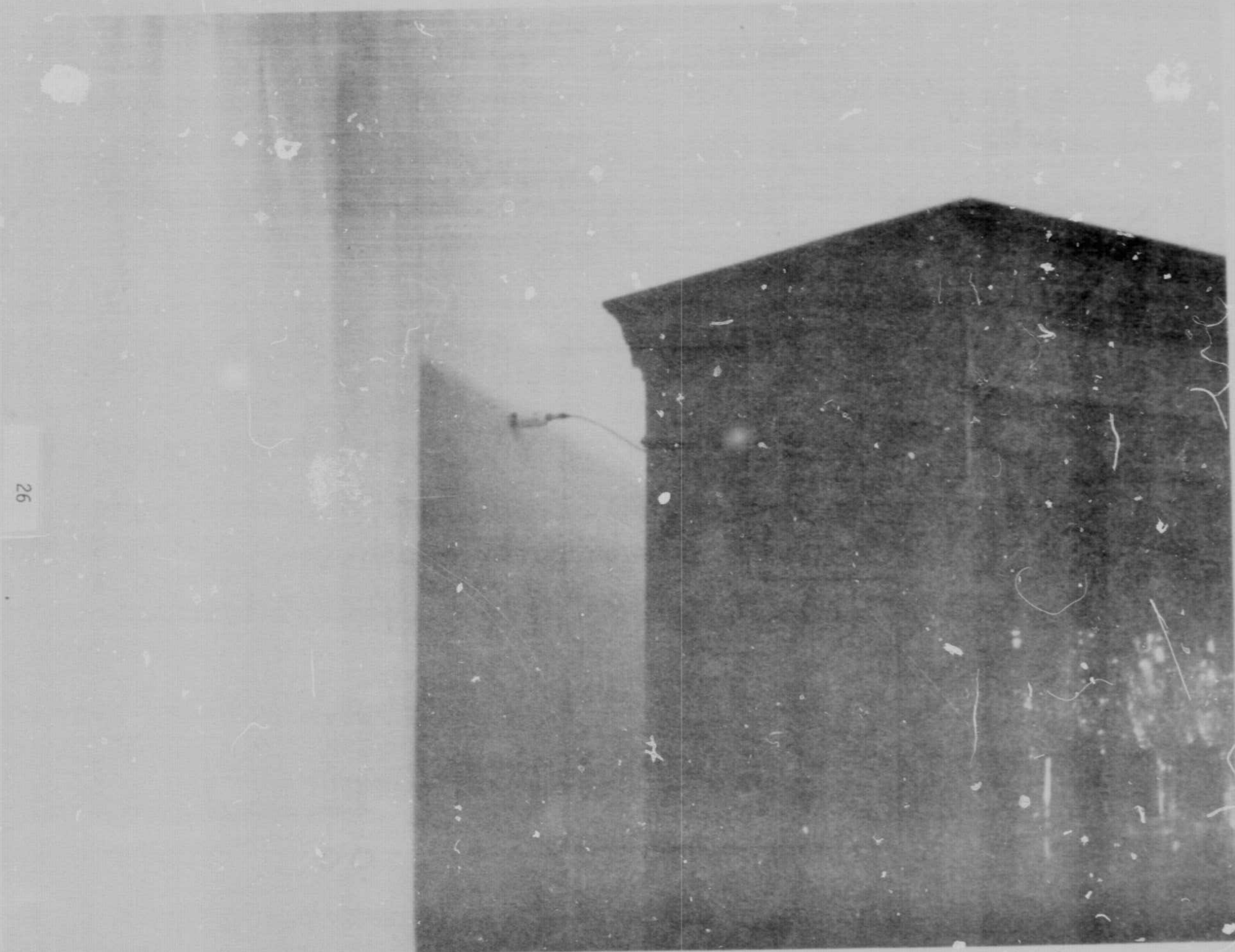

Figure 2(c). Location of accelerometer for wall vibration measurements. Site 2.

Figure 2(d). Location of accelerometer for window vibration measurements. Site 2.

Figure 3(a). West elevation view of test structure 3.

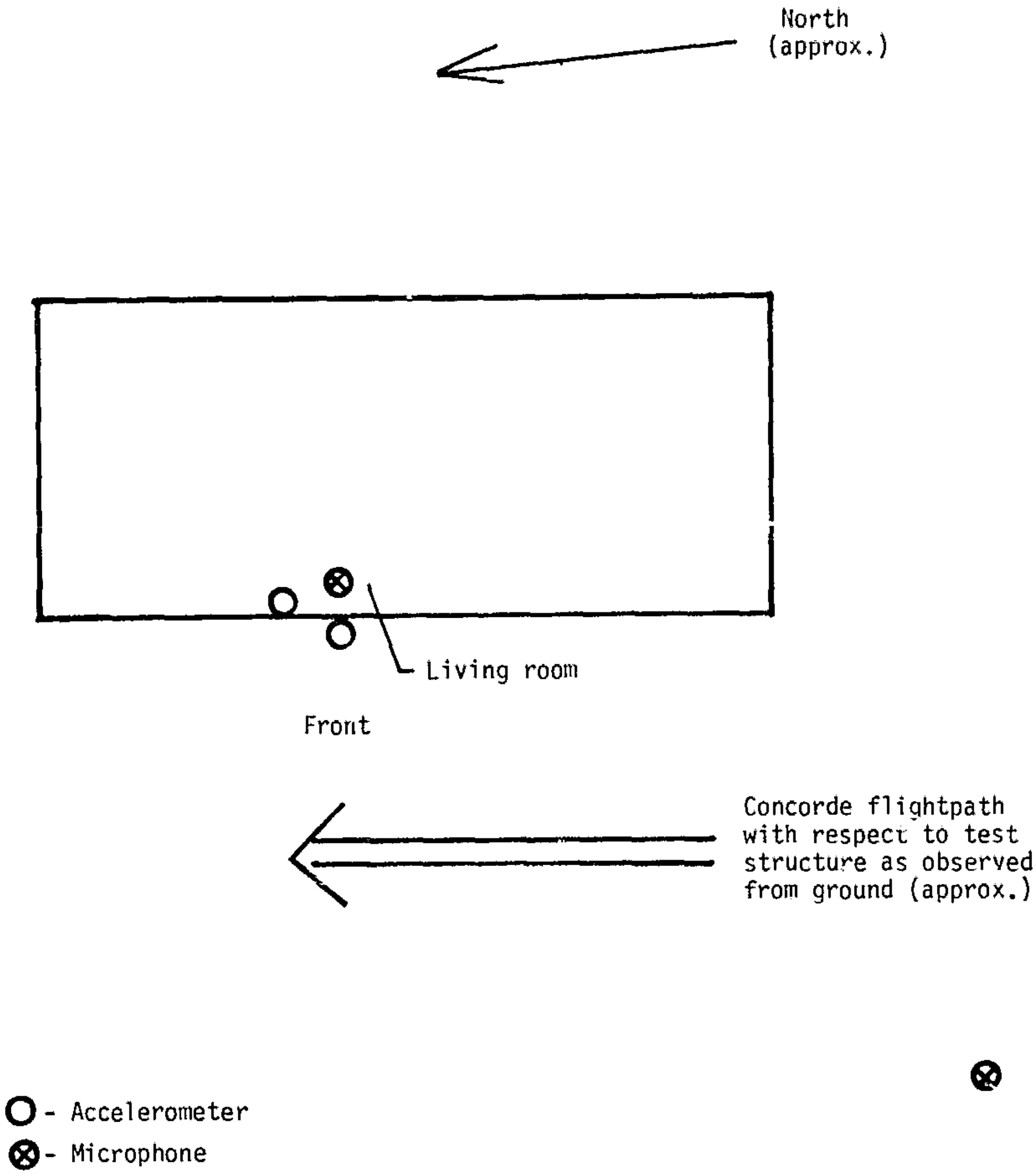

Figure 3(b). Plan view sketch of test structure 3.

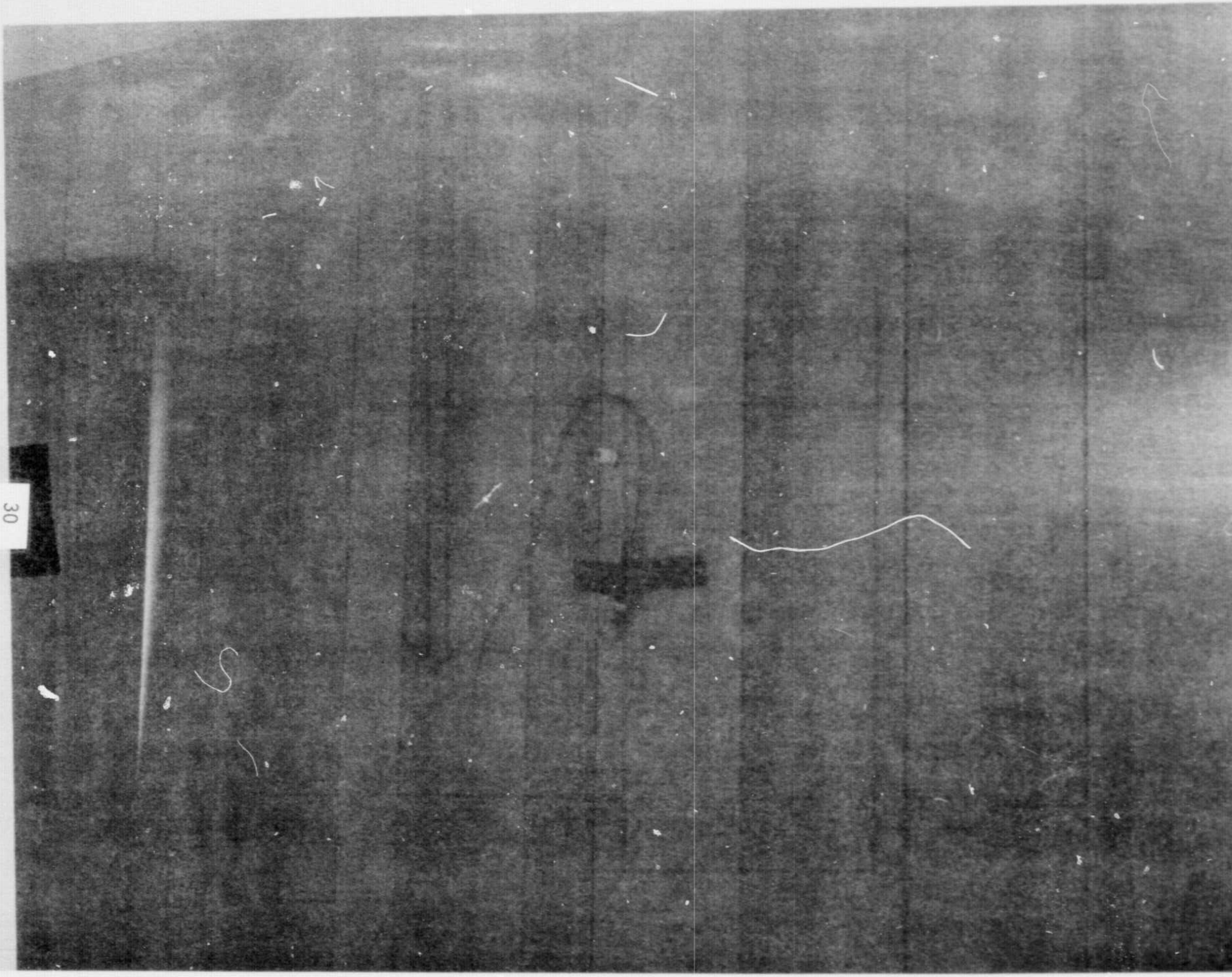

Figure 3(c). Location of accelerometer for wall vibration measurements. Site 3.

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Figure 3(d). Location of accelerometer for window vibration measurements. Site 3.

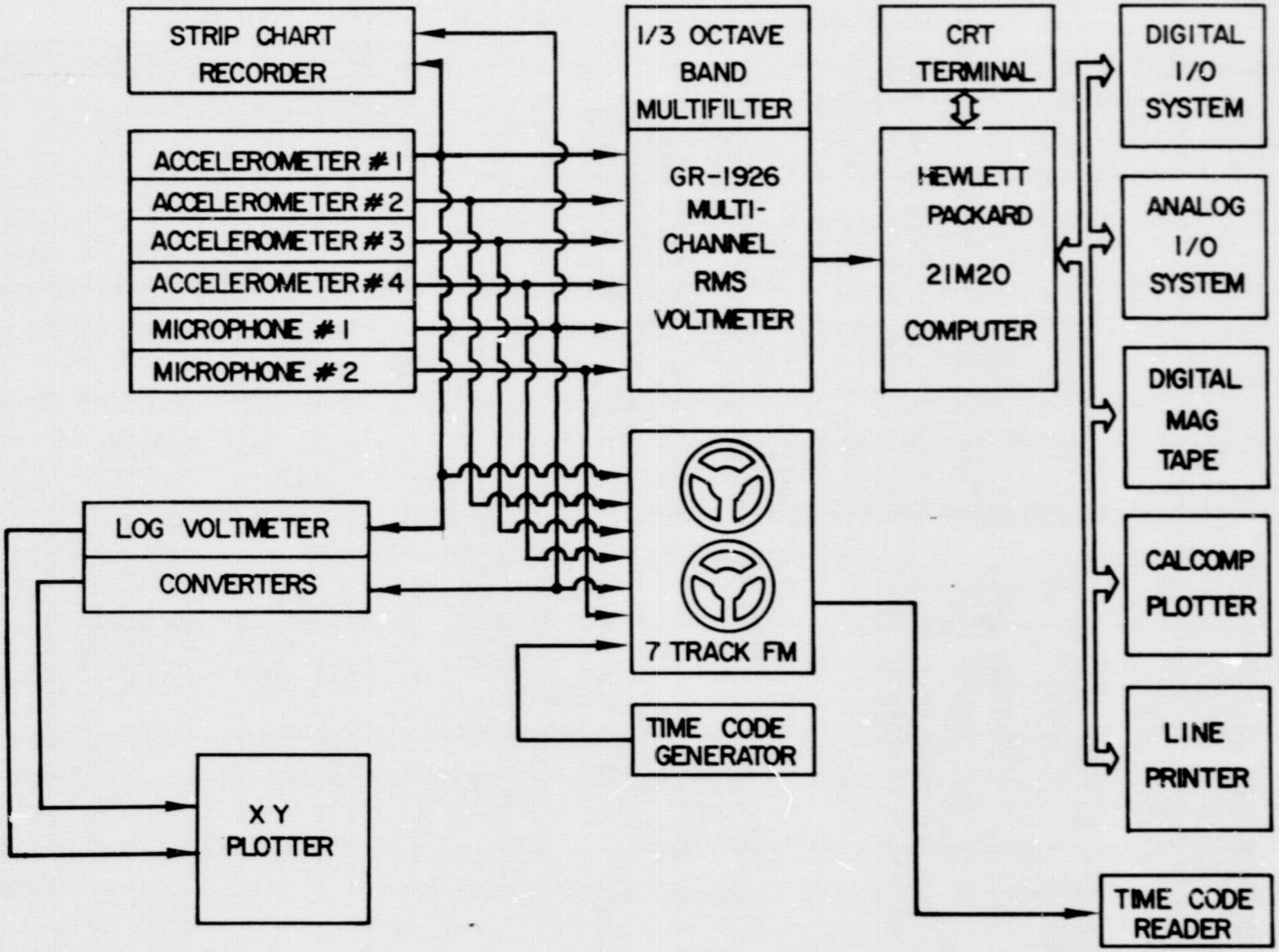

Figure 4.- Block diagrams of mobile data acquisition and processing system.

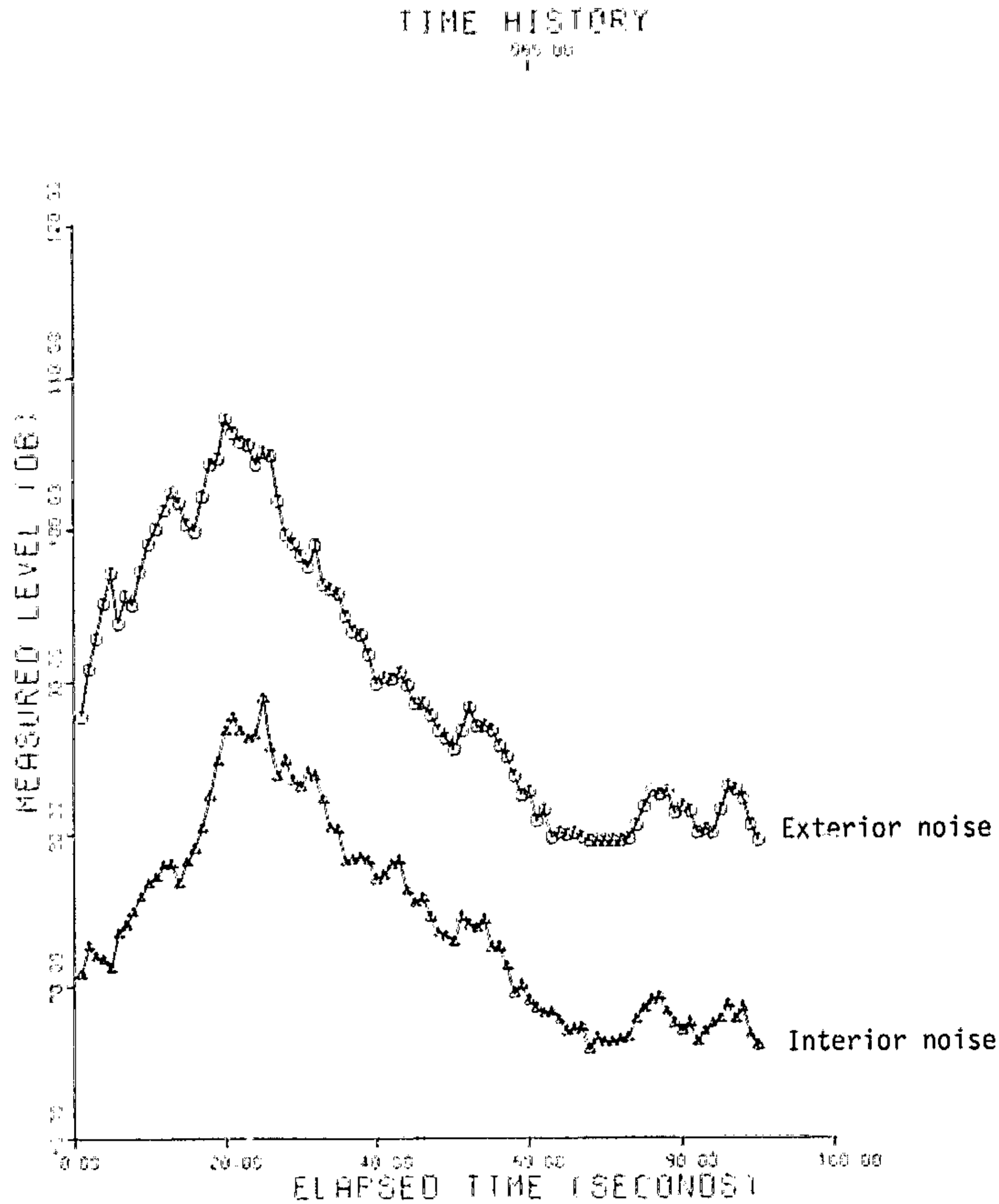

Figure 5(a).- Time history of sound pressure levels during Concorde takeoff.
(event 665 at site 3)

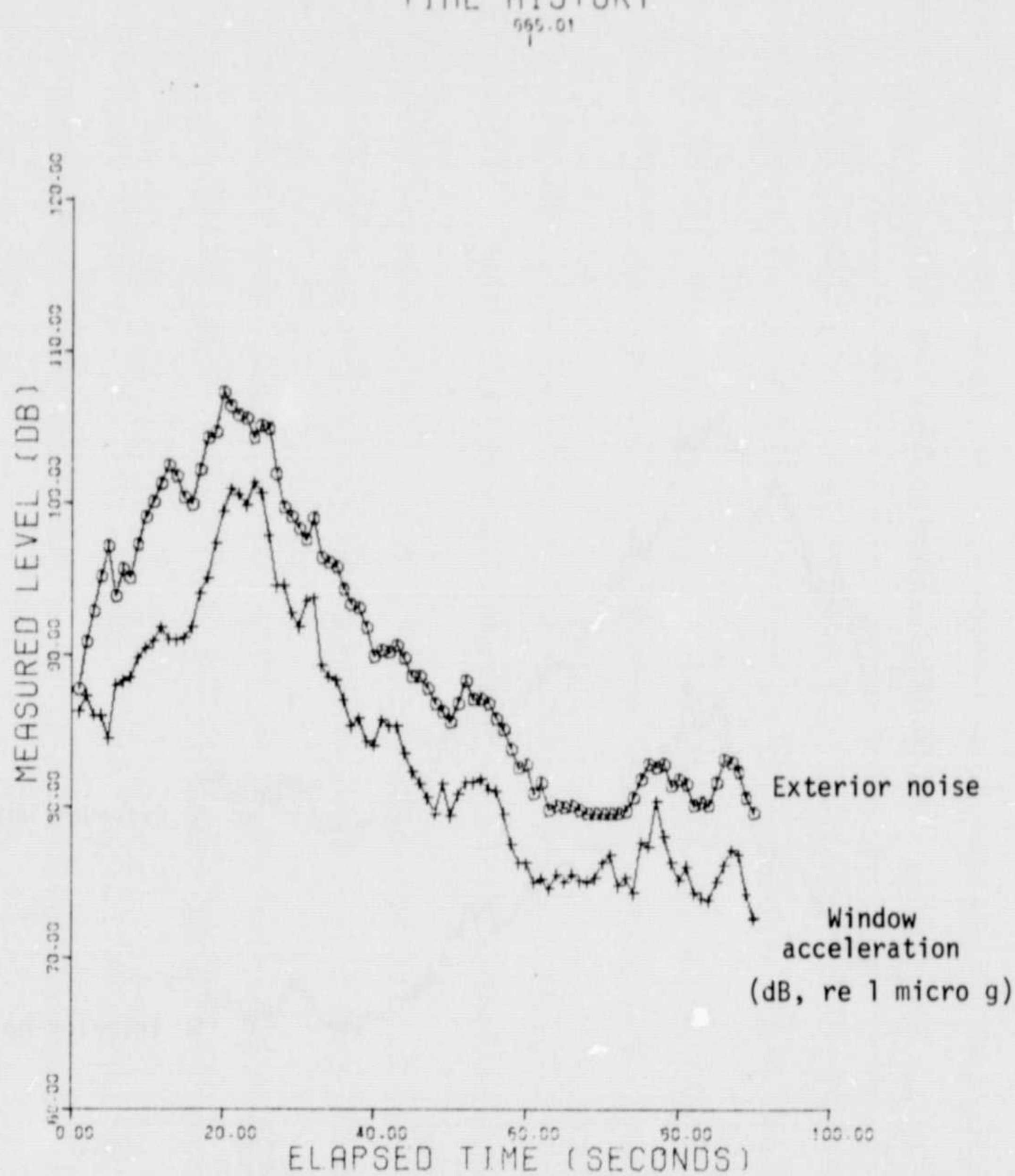

Figure 5(b).- Time history of sound pressure level and window acceleration level during Concorde takeoff.
(event 665 at site 3)

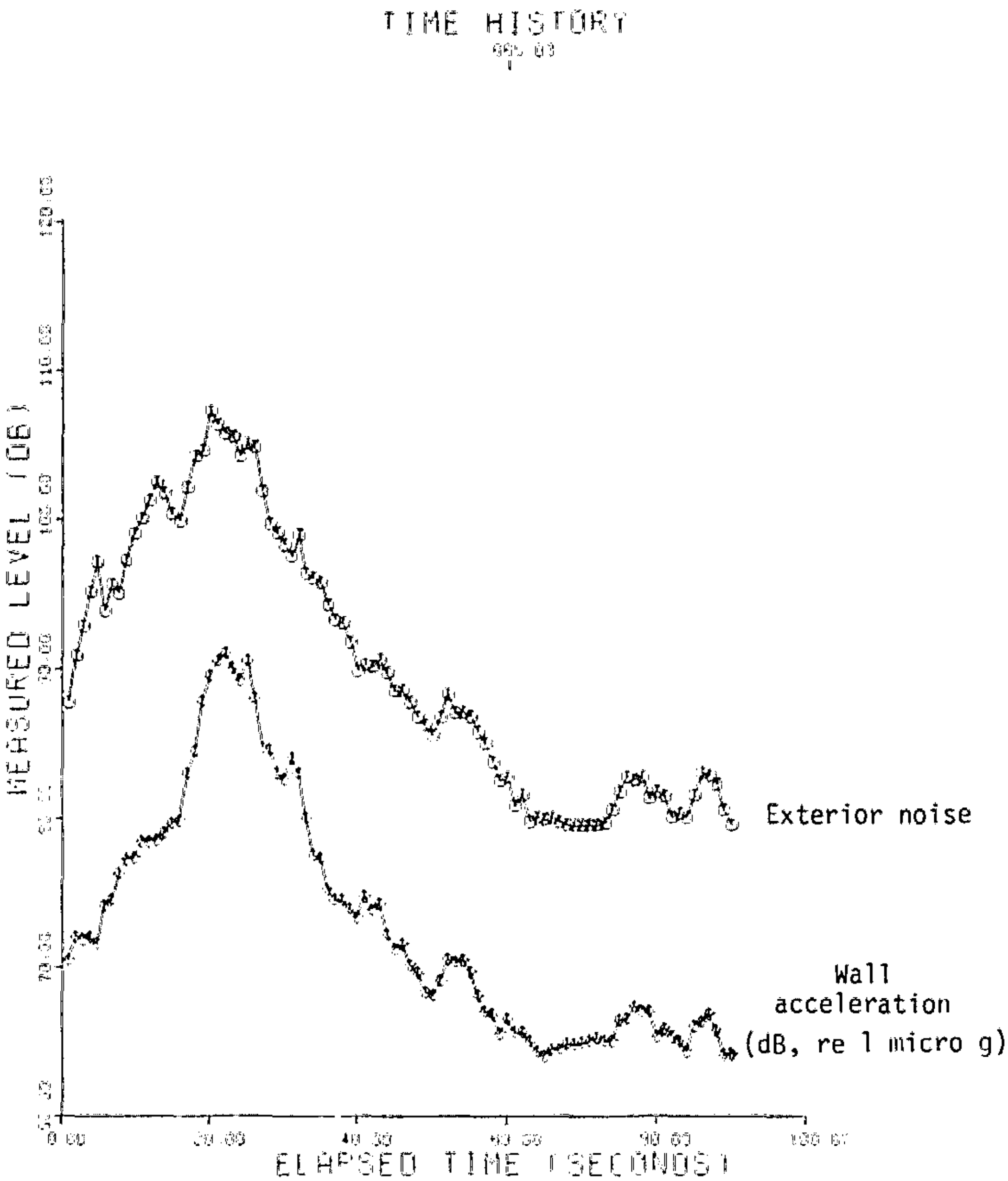

Figure 5(c).- Time history of sound pressure level and wall acceleration level during Concorde takeoff.
(event 665 at site 3)

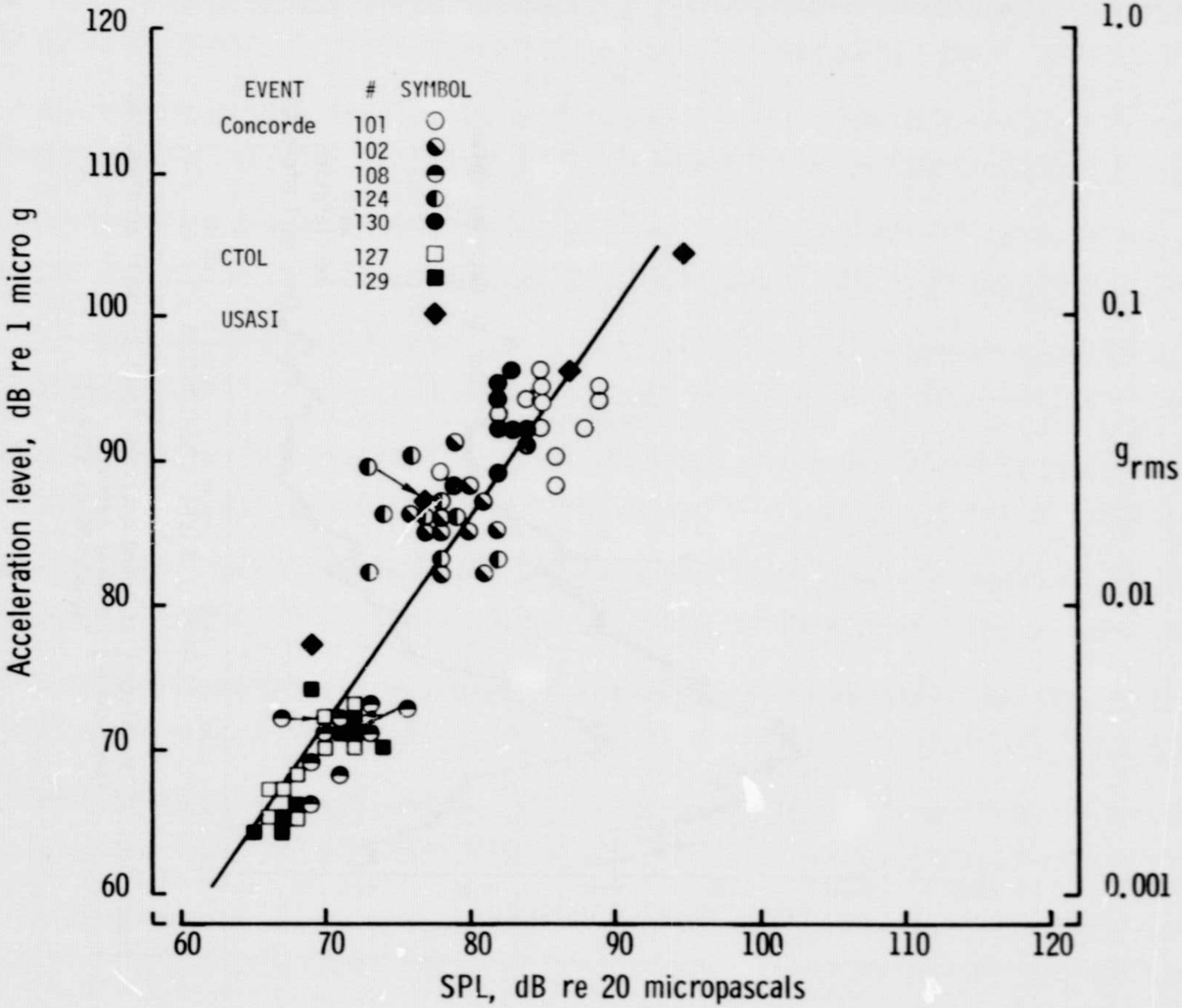

Figure 6.- Vibration response signatures

(a) Site 1 - Window

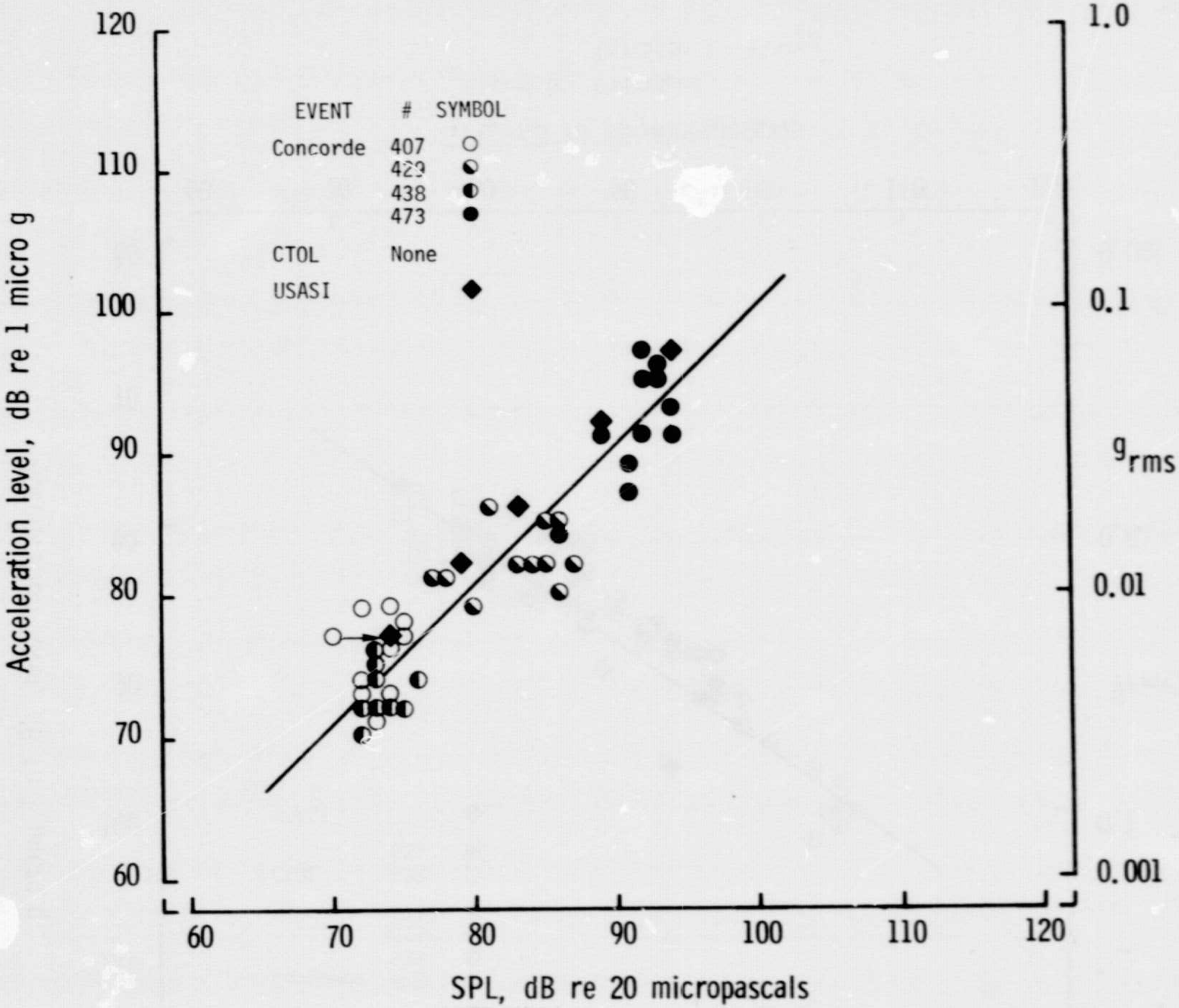

Figure 6.- Continued

(b) Site 2 - Window

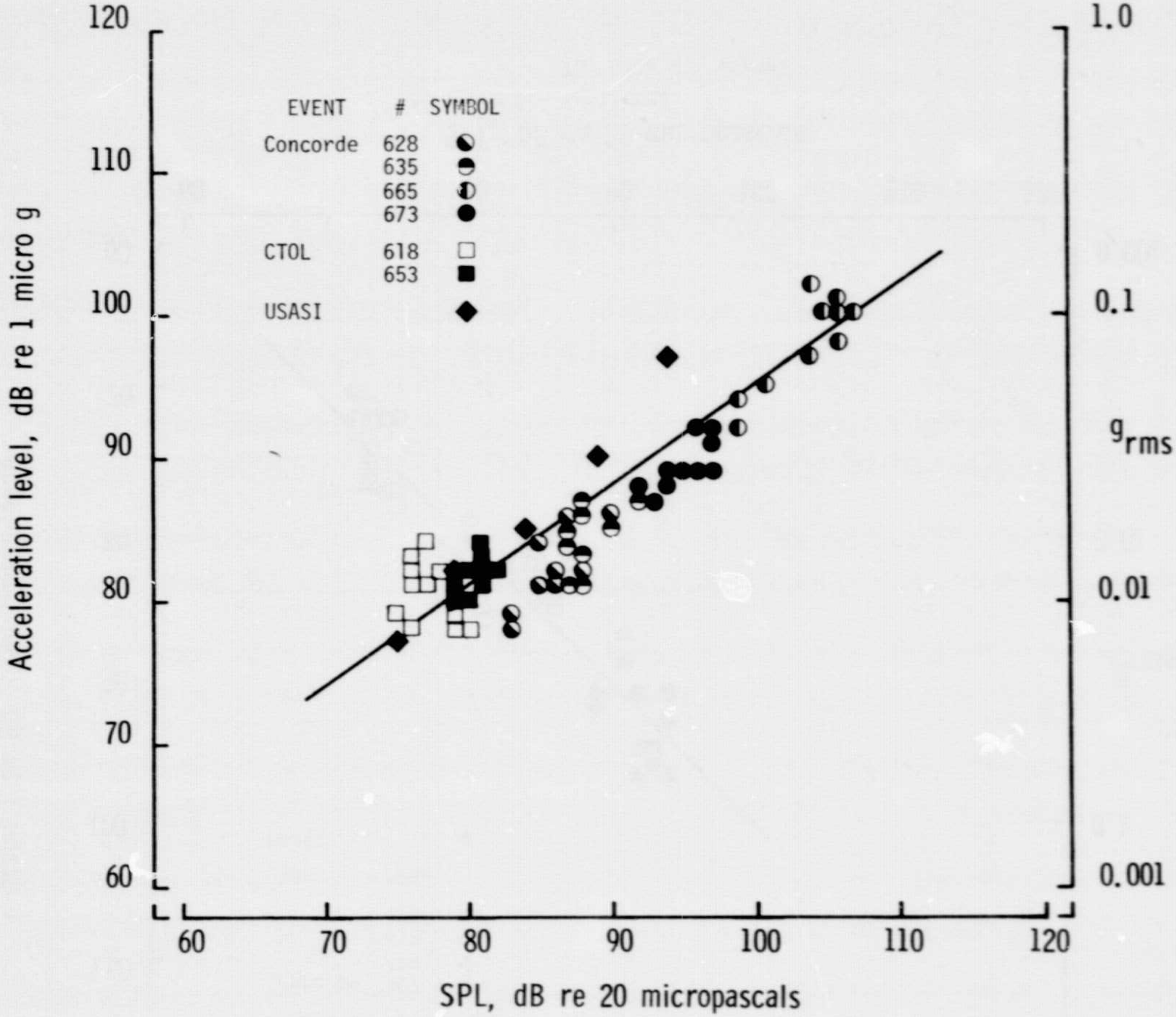

Figure 6.- Continued

(c) Site 3 - Window

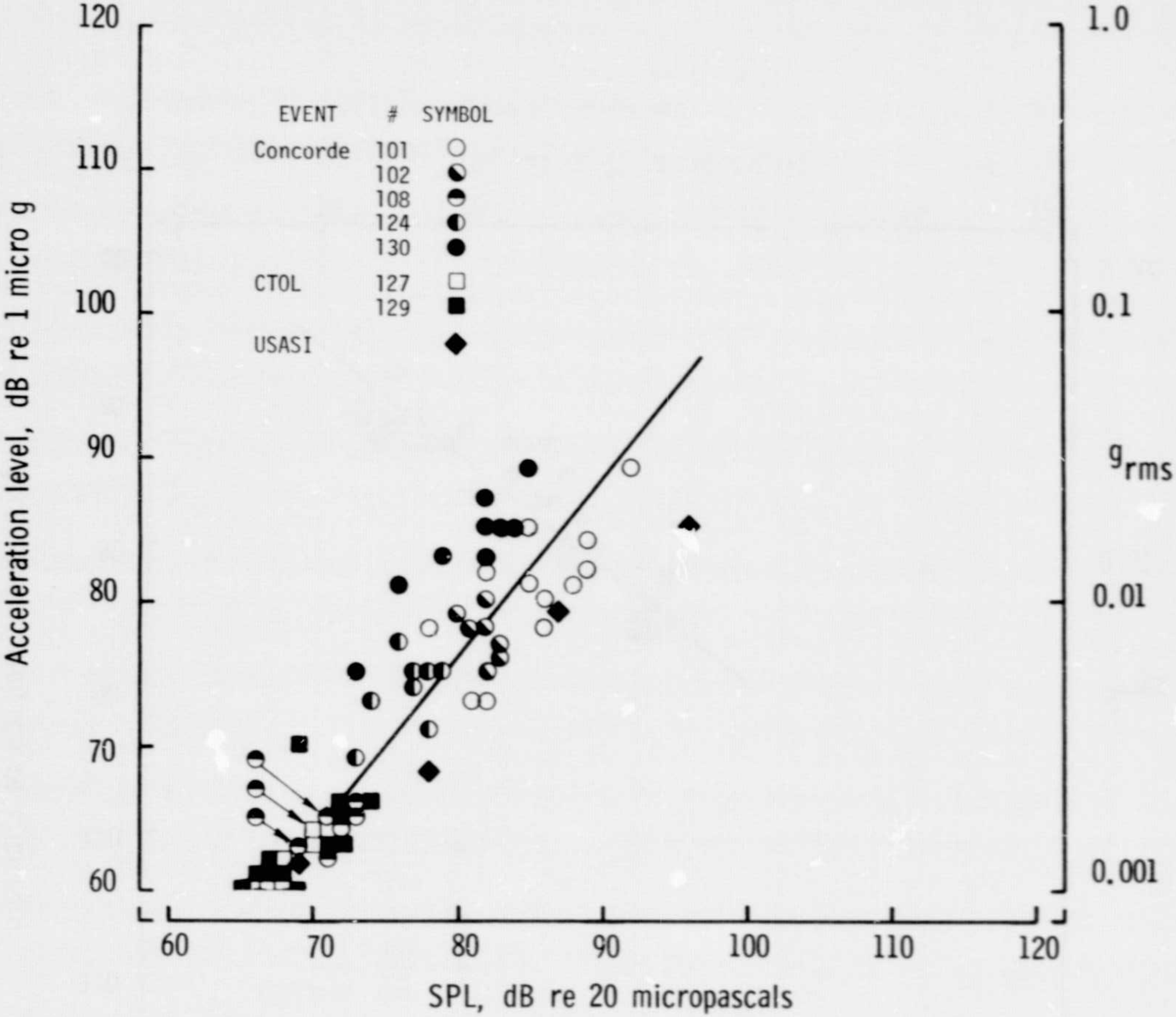

Figure 6.- Continued

(d) Site 1 - Wall

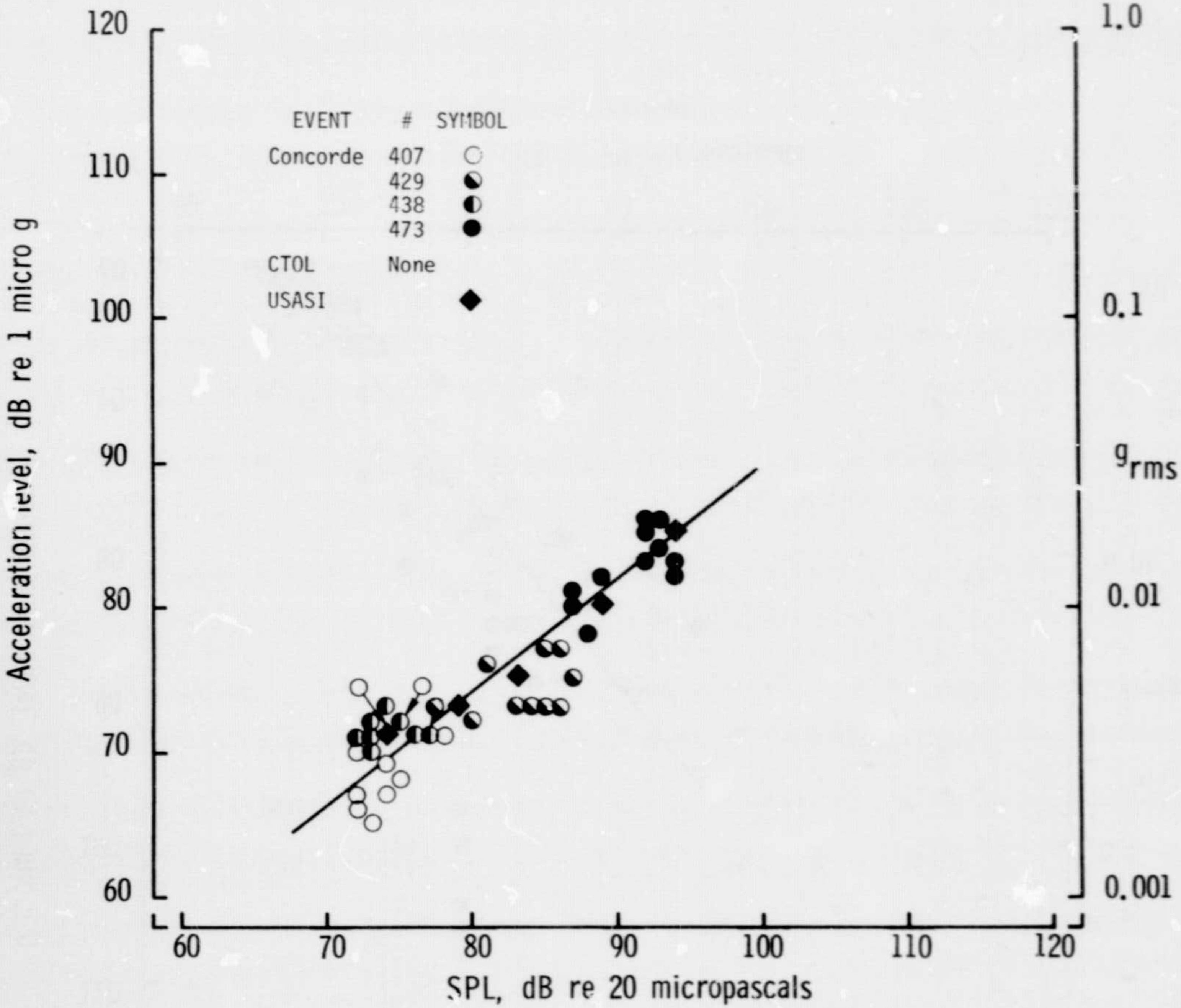

Figure 6.- Continued

(e) Site 2 - Wall

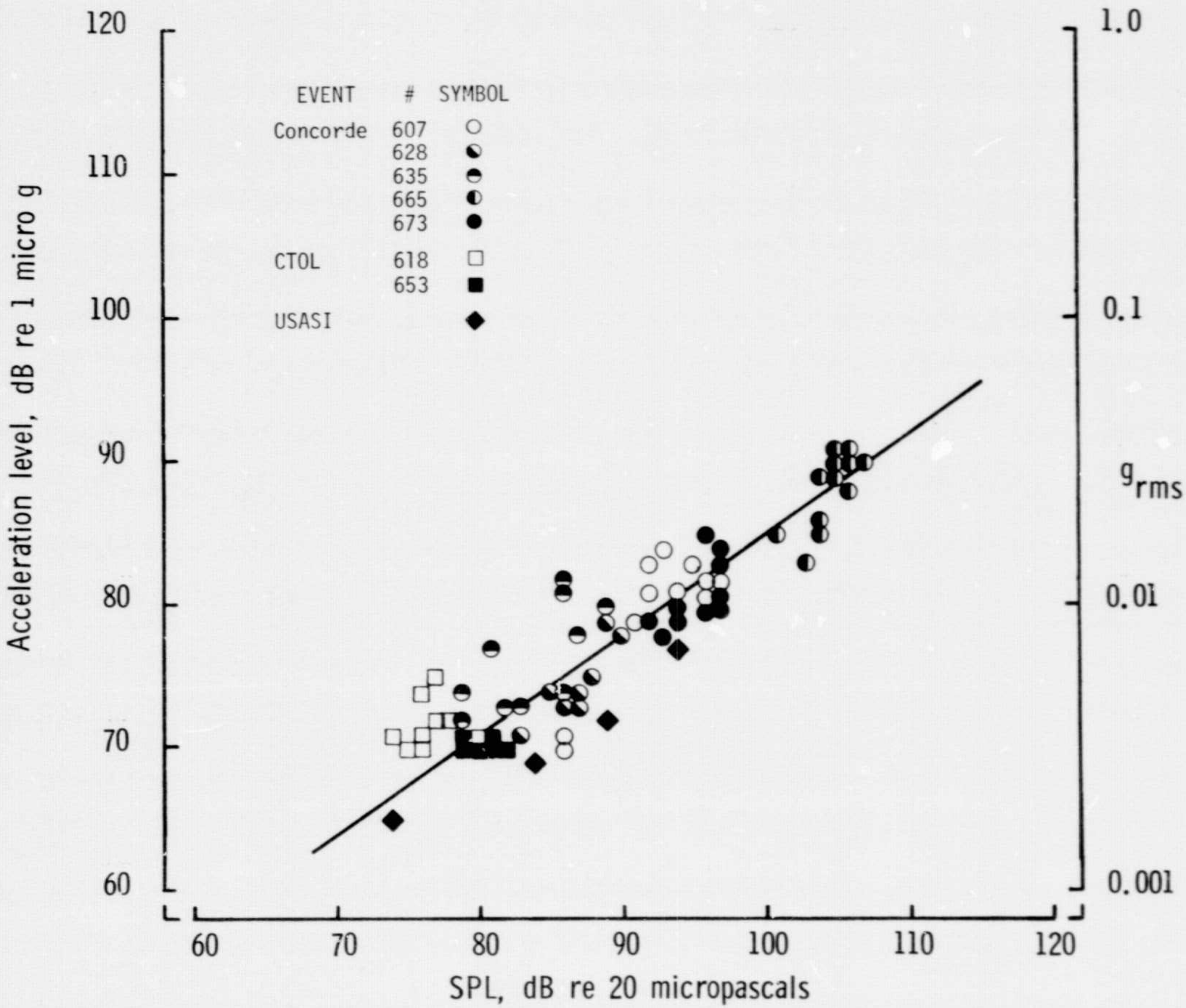

Figure 6.- Continued

(f) Site 3 - Wall